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ABSTRACT

The Science in Action series is designed to teach practical science concepts to special-needs students. It is intended to develop students' problem-solving skills by teaching them to observe, record, analyze, conclude, and predict. This document contains a student workbook which deals with basic concepts about how the earth moves and its relationship to other planets and the sun. Six separate units include: (1) what is your space address; (2) the planet we live on; (3) our moon; (4) our sun; (5) our solar system; and (6) exploring our solar system. The units consist of basic introductory information and questions, worksheets, a self-checking quiz, and instructions for experiments. A cumulative test is provided at the end of the workbook, along with a glossary. The teachers guide (which is included) explains how to use the workbook, together with teaching suggestions and enrichment activities for each unit. (TW)

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The Solar System

Earth Science in Action

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The Solar System

Earth Science in Action

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Teacher's Manual

The Solar System

Susan D. Echaore

A Janus **Earth Science in Action** Book

Teacher's Manual written by Susan D. Echaore

OVERVIEW

Real-Life Science

Are your special-needs students interested in video games and science-fiction movies, but not in science? We believe that science can also be interesting to those students—when it actively involves them in ways geared to their interests and skills.

We wrote ***The Solar System*** especially for the older adolescent with reading and learning problems. Through interesting, hands-on activities, clear and easy-to-understand explanations, and specially tailored lessons, your students discover that science is a real and important part of their lives. Students learn basic concepts about how the Earth moves and its relationships to other planets and the sun. They learn about space probes and current attempts to find out more about space. And they are encouraged to seek up-to-the-minute information from real-life sources.

Designed for Special Students

The Solar System is a workbook that can give your students basic knowledge of the solar system. It can also provide a science foundation your more skillful students can build on. You can expand the teaching in each unit to fit the skills of those students by adding your own lessons and activities. Or you can direct students to the more challenging activities at the end of each unit.

The Solar System is one of a set of Janus ***Earth Science in Action*** workbooks in the Janus ***Science in Action*** series. (Other Janus sets are ***Life Science in Action*** and ***Physical Science in Action***.) This workbook can help your students meet general science and laboratory science requirements. It can be used as a supplement to or as the core of your science program.

OBJECTIVES OF THIS WORKBOOK

The Janus *Science in Action* series helps special-needs students learn basic and practical science concepts that they can apply to daily living. The series also helps students develop problem-solving and thinking skills by teaching them to observe, analyze, conclude, and predict.

Objectives of *The Solar System* are:

- The student will learn what our solar system consists of.
- The student will learn some basic facts about the planets and two of their major movements (rotation and revolution).
- The student will learn about some of the properties of the sun and planets in the solar system.
- The student will learn a vocabulary of useful science words that describe the solar system and space exploration.
- The student will learn about some recent ways that scientists explore the solar system.

READABILITY

The average reading level of *The Solar System* is below 2.5, according to the revised Spache Readability Formula. Target words that are particularly useful for understanding science concepts are listed and defined in a glossary at the end of the book. Those words are set in boldface type wherever they first appear in the text.

You'll find target words for each unit listed in this manual under "Teaching the Units."

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We suggest that you review the target words with your students before they begin a unit. Review pronunciation, and encourage your students to look up definitions in the glossary. Reinforce learning with written and oral vocabulary activities, such as spelling and other word games.

HOW TO USE THIS WORKBOOK

The Workbook Format

The Solar System is formatted so that your students can recognize what to do on each page.

Each unit opens with a one-page introduction. Topic questions focus your students on the major concepts they'll learn. And "Before You Start," a short vocabulary exercise, prepares students for the reading.

Each unit is divided into one-page and two-page lessons that are followed by an activity.

And each unit ends with "Check Yourself," a comprehensive exercise, and "Check These Out," a list of additional activities that reinforce and expand the teaching in each unit. The activities are multi-modal to meet the different skill levels of your students.

Introducing the Book

You might get students ready for *The Solar System* by leading them in a discussion about space.

Encourage students to talk about science TV programs, movies, books, comic strips, etc., that they are enthusiastic about. Tell them they are going to learn some science facts upon which those stories are based.

Distribute the workbooks, and give students time to leaf through the book. Randomly pick out a few pages, and point out what students will learn.

Finally, read the introduction out loud. Ask your students to guess what the one true star in our solar system is. (The answer is the sun.)

Introducing the Unit

Read the introduction out loud, and discuss the topic questions with your students. You might have your students guess answers to the questions. Then, at the end of the unit, have students again answer the questions so they can see how much they've learned.

After students have completed "Before You Start," review the words with them. Make sure your students understand the words before starting the first lesson, since those words will help them understand the concepts taught in the unit.

Teaching Suggestions

Helping Your Students Succeed

Many learning-disabled students have difficulty working independently, especially in a subject such as science. So we suggest that you keep students together, and pace learning. Walk them through new exercises and activities. Encourage discussions that help students understand the concepts.

We strongly suggest that you closely supervise and guide your students through the activities. Lead them through each step. Discuss their findings and help them arrive at correct conclusions.

Be Prepared!

To ensure successful learning, be ready for the special needs of your students and the special problems that may arise.

Read each unit yourself before you assign it and be prepared to discuss the concepts in that unit. A bibliography at the end of this manual lists some publications that can quickly give you a general knowledge of the solar system.

Gather materials and do activities yourself ahead of time, so you'll know what should happen and what could go wrong. You may need to adjust some of the activities to fit the skills of your students.

Have ready a variety of bonus activities for those students who finish a lesson early. Make sure activities match the different skills of your students. And plan enrichment activities that take students out of the classroom and into the community. Through such activities, students see that science is an integral part of their daily lives. You'll find some suggestions for activities in this manual.

End-of-the-Book Exercises

"Show What You Learned" is a page of two brief comprehensive tests that end the workbook. "What's the Answer?" tests understanding of major concepts taught in the book. "What's the Word?" tests knowledge of some target words.

About the Glossary

Words that appear in boldface type are listed and defined in a glossary at the end of the workbook.

The words are divided into syllables to help students decode. Definitions are deliberately narrow to pertain only to those science concepts taught in *The Solar System*.

TEACHING THE UNITS

Unit 1: What's Your Space Address?

Target Words: *galaxy, planet, solar system, star, star system, true star*

This unit helps students understand that they are part of the universe by pointing out Earth's place in the solar system. This book does not discuss the universe, so you may wish to introduce that concept.

PAGE 5: **Coming Home**

Students imagine that they're traveling through space. They learn that our solar system is contained in a galaxy. Space around a spaceship is black when stars are so far away that their light can't reach the ship.

PAGE 6: **Galaxy Ahead!**

Our galaxy is the *Milky Way,* and it is shaped like a spiral, or whirlpool, with two trailing "claws." Our solar system is located at the edge of one of those claws.

PAGE 6: **Star Ahead!**

Our sun is a true star. Some "stars" in the night sky are really planets that reflect the light of the sun. True stars are composed mostly of superheated burning hydrogen and helium gases.

PAGE 7: **Star System Ahead!**

A star system is a star and its satellites. Our sun is part of a star system called the solar system.

PAGE 7: **Home!**

Students learn that Earth is in the solar system. They return to Earth and end their imaginary space trip. Planet: *Earth;* Star System: *Solar System;* Galaxy: *Milky Way*

PAGE 8: **Check Yourself**

1. A large group of stars is called a *galaxy.* **2.** Our sun is a true *star.* **3.** Our sun and nine planets are part of the *solar* system. **4.** The planet *Earth* is part of the solar system. **5.** Our galaxy is called the *Milky Way.*

Enrichment Activities

- Arrange a field trip to an observatory.
- Encourage your students to bring in movie and TV-show clippings, songs, and so on about space.
- Go to a science-fiction movie together. Discuss what is fiction and fact about the movie.

Unit 2: The Planet We Live On

Target Words: *atmosphere, axis, gravity, NASA, rotate, tilt*

Students look at Earth as a planet and a member of the solar system. Students learn about gravity and one of Earth's movements, rotation.

PAGE 10: **Planet Earth**

Earth's shape has been likened to a soft beach ball. Help students conclude that Earth isn't perfectly round; point out that Earth bulges at the equatorial belt and flattens out at the poles. Direct students to the NASA photograph of Earth. Discuss the fact that Earth has an atmosphere and clouds. (Later in the book, students will see photographs of other planets and learn about recent findings about the atmospheres of those planets.)

PAGE 11: **Sticking to Earth**

Our planet has a force that holds things close to it—gravity. If it didn't have gravity, nothing could stay on Earth. (Later, students will learn that, like Earth, the sun and other planets have gravity.)

PAGE 12: **Earth Spins**

Students learn that Earth rotates, or spins, around its axis. (Earth's axis is an imaginary line that runs through the center of Earth from the North Pole to the South Pole, and that tilts 12½ degrees to the plane of Earth's orbit.) We suggest you obtain a top, like the one pictured on the page, so students can actually see rotation.

PAGE 13: **Make a Model**

Materials: *Styrofoam ball, sharpened pencil*

This activity allows students to kinesthetically learn how Earth rotates. Guide students through the making of their models. Make sure their pencils go through the center of the ball. Then guide them through the activity. This model will be used in later activities.

PAGE 14: **Night and Day**

Materials: *model of Earth, lamp* (without a lampshade), *a straight pin*

Students learn that Earth's rotation causes night and day. They then kinesthetically see that for themselves in an activity using the model they made for the previous activity. Guide students through this activity.

Earth takes 24 hours to completely rotate.

PAGE 15: **Check Yourself**

Answers to puzzle: *Across* **2.** Earth **5.** atmosphere **7.** night **8.** day *Down* **1.** North Pole **3.** rotate **4.** gravity **5.** axis **6.** South Pole

Enrichment Activities

- Show movies or filmstrips about recent scientific theories of the beginning of Earth.
- Start a class project to build a model of the solar system and suspend it from the ceiling.

Unit 3: Our Moon

Target Words: *reflect, revolve, satellite*

In this unit, students learn about the planet that is closest to Earth—its satellite. The moon is round, like Earth. And like Earth it has gravity and it rotates. Students learn about revolution in this unit.

PAGE 17: **Earth's Satellite**

The moon is a small planet, one-fourth the size of Earth. It is Earth's satellite because Earth's gravity keeps it in orbit around Earth. Help students conclude what the moon's surface would look like by showing them NASA photographs and artists' renditions.

PAGE 18: **Moonshine**

Materials: *model of the moon* (use the model created for unit 2), *a world globe or basketball, a lamp*

This activity kinesthetically teaches students that they see the moon because it reflects the sun's light. Point out that Earth and everything in the solar sytem reflect the sun's light. (Note: The moon also tilts but its tilt is five degrees to the plane of its orbit.)

PAGE 19: **Does the Moon Have Gravity?**

Students learn that the moon's gravity is weaker than Earth's, and that the moon's gravity isn't strong enough to hold water or atmosphere. The moon's gravity, however, pulls on Earth's oceans and (with the sun's gravity) causes high and low ocean tides.

PAGE 20: **The Moon Moves**

Materials: *model of the moon, a world globe or basketball*

This activity teaches students that the moon revolves around Earth. (Students will later learn that the Earth and other planets move around the sun in a similar way.)

PAGE 21: **Changing Shapes**

Students learn that the moon appears to change shapes because it revolves around Earth. As the moon revolves, we see different portions of its surface reflected by the sun. A *new moon* describes the moon when it is between Earth and the sun; a *quarter moon* (actually, a first quarter moon), when the moon is a fourth way into its orbit; a *full moon,* when the moon is halfway around its orbit and directly facing the sun; and a (last) quarter moon again when the moon has completed three-fourths of its journey. You might bring in a lunar calendar to show to and discuss with the class.

PAGE 22: **Another Way the Moon Moves**

Materials: *a chair*

This activity kinesthetically teaches students that the moon rotates, and that we always see the same side of the moon because it rotates. Help students conclude that we would see all sides of the moon if it didn't rotate.

PAGE 23: **The Moon Rotates and Revolves**

Materials: *model of the moon, a world globe or basketball, a straight pin*

This activity kinesthetically teaches students that the moon rotates as it revolves around Earth. The moon completes a rotation and a revolution at about the same time (about 27 to 29 days). You might have the class compare the moon's and Earth's rotations.

PAGE 24: **Check Yourself**

1. (The moon is) **c.** Earth's satellite. **2.** (The moon shines because) **b.** it reflects the sun's light. **3.** (The moon's gravity is) **a.** weaker than Earth's gravity. **4.** (Earth's gravity holds the) **e.** moon close to Earth. **5.** (The moon rotates as it) **f.** revolves around Earth. **6.** (As the moon revolves, its) **d.** shape seems to change.

Enrichment Activities

- Make a papier-mâché model of the moon and hang it next to the model of Earth.
- If you live near an ocean, arrange a field trip to a place where students can observe low and high tides.

Unit 4: Our Sun

Target Words: *ellipse, orbit, seasons, Sol*

Now that students understand gravity, rotation, and revolution, they can more easily understand the concept of Earth moving around the sun.

PAGE 26: **Sol**

Students learn that our sun is at the center of the solar system. Point out that life on Earth depends on the Earth's position next to the sun. You might expand the teaching by discussing the various ways the sun supports life on Earth—for example, as a source of energy.

PAGE 27: **Our Giant Sun**

Materials: *a basketball, a piece of bread or clay*

The sun is the largest object in our solar system, and its gravity is greater than that of all the objects around it. Thus, the sun's gravity holds together everything in the solar system. Students compare the sizes of Earth and the sun. (Some sources cite the sun as a hundred times larger than Earth.)

PAGE 28: **Moving around the Sun**

Materials: *model of Earth, a lamp*

This activity teaches students that Earth revolves around the sun and that its path is called an orbit. Help students conclude that when a calendar year is finished, Earth has completed one revolution. (Note: The diagram exaggerates the shape of Earth's orbit so students can see the ellipse. In space, Earth's ellipse is less extreme.)

PAGE 29: **Changing Seasons**

Students learn that Earth has changing seasons because it revolves around the sun and because of its tilt. You might demonstrate Earth's positions during each of the four seasons with a model of the Earth and a globe. Lead students to conclude that seasons are different at the equator and in the northern and southern hemispheres. Discuss how and why they are different.

PAGE 30: **Check Yourself**

Answers to puzzle: *Across* **1.** gases **2.** star **3.** revolves **6.** light **7.** seasons *Down* **1.** gravity **4.** ellipse **5.** Sol **8.** orbit

Enrichment Activities

- Arrange a field trip to a solar energy exhibit.
- Show a film on why living things depend on the sun.
- Have students make a papier-mâché sun to add to the room's model of the solar system.

Unit 5: Our Solar System

Target Words: *asteroids, collide, comets, crater, meteorites, meteoroids, meteors, object*

Students learn that all heavenly bodies in the solar system revolve around the sun, the way Earth does.

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PAGE 32: **Sol's Planets**

There are nine known planets in our solar system, all of different sizes and at different distances from the sun. Earth is the third planet from the sun. Planets that have moons are: Earth, Mars, Jupiter, Saturn, Uranus, Neptune, and Pluto. Planets that don't have moons are Mercury and Venus.

PAGE 33: **Going around in Orbits**

All planets revolve around the sun, and the time it takes a planet to complete a revolution is called that planet's year. Since the planets revolve at different speeds, each planet completes a revolution at a different time. Thus, the nine planets have different planet years. The planets stay in their orbits because the sun's gravity keeps them there.

PAGE 33: **The Worlds Turn**

Students learn that, like Earth, every planet rotates around its axis and that each planet rotates at a different speed. The time it takes to complete a rotation is called the planet's day. Thus, an Earth day is 24 hours long. Help students understand the difference between a planet day and the 12-hour day they are familiar with.

Jupiter spins faster than Earth; Earth spins faster than Mercury.

PAGE 34: **Asteroids**

Students learn that asteroids are small planetlike objects that revolve around the sun. Most are in a band that goes around the sun (like a belt) between the orbits of Mars and Jupiter.

PAGE 35: **Comets**

Students are introduced to two comets: Comet Kohoutek, which was sighted in 1973, and Halley's Comet. Halley's comet takes about 76–77 years to complete its orbit and most references cite 1986 as the year of its next appearance. For easy arithmetic, this workbook says that the comet takes 76 years to complete its orbit.

PAGE 36: **Meteoroids**

Students are introduced to two comets: Comet Kohoutek, which was sighted in 1973, and Halley's Comet. Halley's comet takes about 76–77 years to complete its orbit and most references cite late 2061 as the year of its next appearance. For easy arithmetic, this workbook says that the comet takes 76 years to complete its orbit.

PAGE 37: **Check Yourself**

1. (The solar system is the sun) **c.** and all the objects around it. **2.** (Planets, asteroids, comets, and meteoroids) **a.** revolve around the sun. **3.** (All planets rotate) **b.** at different speeds. **4.** (Comets are frozen balls) **e.** of gas, dust, and rock. **5.** (Meteoroids usually burn up in) **d.** Earth's atmosphere. **6.** (Asteroids are sometimes called) **f.** "little planets."

Enrichment Activities

- Arrange a field trip to a planetarium.
- Have your students finish the room's model of the solar system. Students, working in teams, make papier-mâché models of the planets, then position the models according to the drawing on pages 32–33.

Unit 6: Exploring Our Solar System

Target Words: *astronaut, spacecraft, space probe, unmanned spacecraft*

Up until recent times, space explorations could only be done with earthbound instruments, such as telescopes. Space travel has opened up ways to gather more complete information about the solar system. Describe the NASA program to students before beginning the unit.

PAGE 39: **A Giant Leap**

So far, manned spacecraft have traveled to the moon and orbited Earth. But only unmanned spacecraft can be sent on space probes to other planets. You might lead your students in a discussion about recent space probes.

PAGE 40: **Mercury**

Your students learn that Mercury doesn't have an atmosphere, so its surface has many craters. Help students conclude that the craters were made by meteorites.

PAGE 40: **Venus**

Students learn that photographs of Venus reveal clouds in that planet's atmosphere. Those clouds are made of sulfuric acid, unlike Earth clouds which are made of water. Students are asked to use their imagination to describe what kind of life they think might exist on Venus.

PAGE 41: **Mars**

A photograph shows parts of Mars's surface. You might show pictures of similar surfaces on Earth. People have long believed that life may exist on Mars because it has water. You might define to students what "life" means and what signs of life scientists look for.

PAGE 42: **Jupiter**

Students learn one theory about Jupiter's composition: The planet and its atmosphere are mostly made up of gases. The photograph of Jupiter shows colorful bands and stripes, which are Jupiter's clouds.

PAGE 43: **Saturn**

National Geographic, vol. 160, no.1 (July 1981) has a comprehensive report about Saturn, written from recent space-probe information.

PAGE 44: **The Unknown Trio**

Uranus, Neptune, and Pluto were discovered within the last 200 years. Although Voyager II has studied Uranus and is now on its way to Neptune, much is still unknown about the three planets. Help students formulate questions on what they would like to know about these planets. As a follow-up, students can send letters to NASA, requesting information on exactly what is known about the three planets.

PAGE 44: **What Next in Space?**

Scientists hope someday to have space stations located throughout the solar system. People who gather information about space would live in those stations. Presently, scientists are developing a space shuttle that can transport people to and from these space stations. The photograph on this page shows a space shuttle.

PAGE 45: **Check Yourself**

1. Accept all appropriate answers, such as: Manned spacecraft can stay in space for only a short time.
2. Student's opinion

Enrichment Activities

- Set up a bulletin board for students to post ongoing developments in space exploration.
- Have students read and report on a science-fiction story. (Two authors are Ray Bradbury and Isaac Asimov.)

Show What You Learned

PAGE 46: **What's the Answer?**

1. Our solar system is made up of **a.** the sun.; **b.** planets and moons.; **c.** asteroids, comets, and meteoroids. **2.** All planets **b.** rotate around an axis.; **c.** have gravity.; **d.** revolve around the sun. **3.** Earth **a.** is the third planet from the sun.; **b.** rotates completely in 24 hours.; **d.** revolves around the sun in one year. **4.** We have explored our solar system by **a.** sending astronauts to the moon.; **b.** sending unmanned spacecraft on space probes.; **d.** training people to live in space stations.

PAGE 46: **What's the Word?**

1. Gravity **2.** Rotate **3.** Star **4.** Space probes **5.** Orbit **6.** Galaxy

TEACHING AIDS

Resources

Check science departments at your nearby college and university; they often have suggestions and materials that you can use. Inquire at your local Chamber of Commerce or look in newspapers for listings of amateur astronomy groups in your area.

The following organizations have printed and visual materials, such as posters and maps, that you'll find useful:

- National Aeronautics and Space Administration (NASA), Public Affairs Division, Washington, D.C. 20546
- U.S. Geological Survey, 302 National Center, Reston, VA 22090
- Astronomical Society of the Pacific, 1290 24th Avenue, San Francisco, CA 94122
- Astronomy Department, Lawrence Hall of Science, University of California, Berkeley, CA 94720

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This listing includes both works referred to in the text and a selection of books about the solar system.

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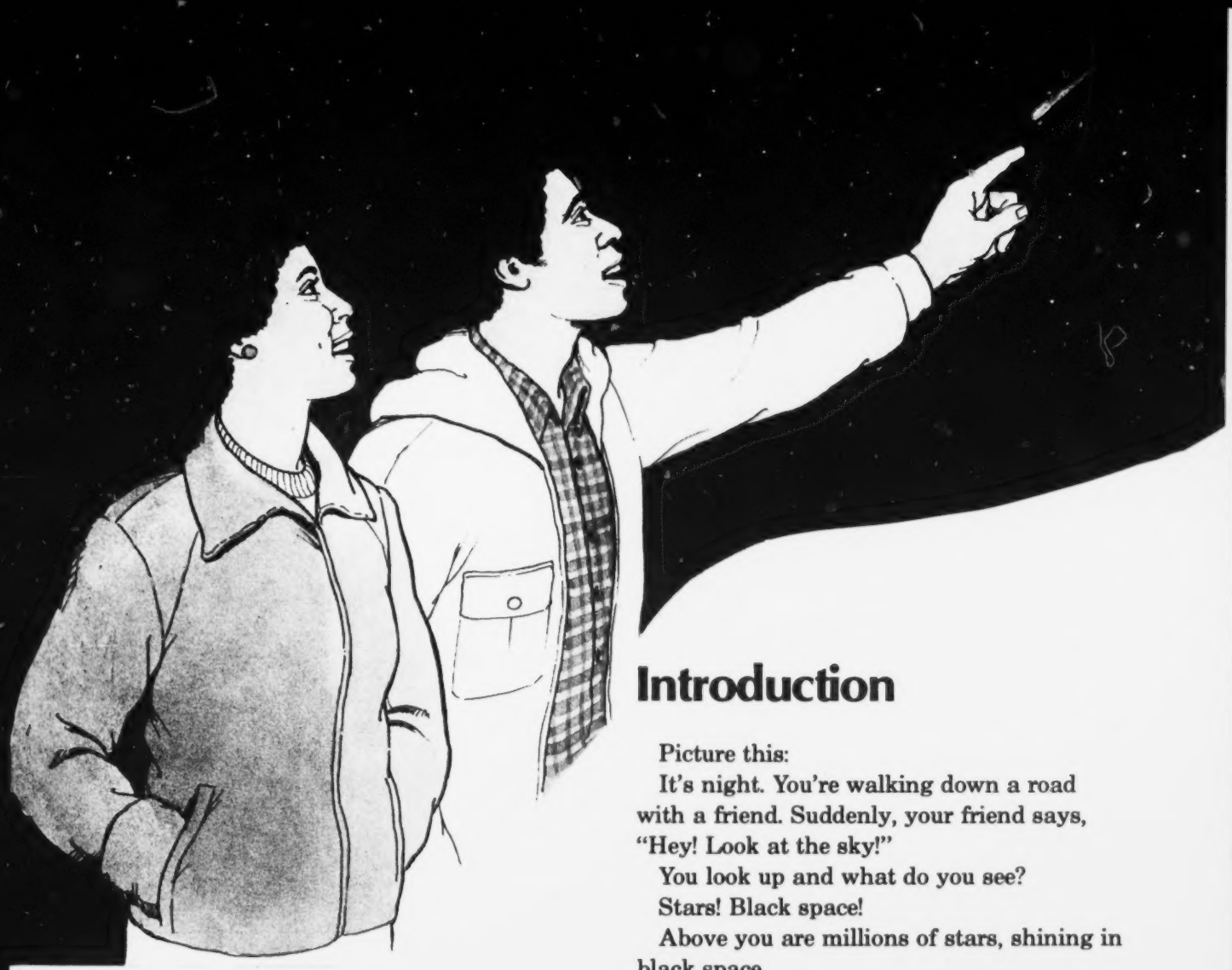


Introduction

Picture this:

It's night. You're walking down a road with a friend. Suddenly, your friend says, "Hey! Look at the sky!"

You look up and what do you see?

Stars! Black space!

Above you are millions of stars, shining in black space.

Did you ever wonder about those stars?

Some of those stars are very far away. Some are close to us. The stars that are close to us *aren't* stars. They are really worlds, something like the world we live on.

Those worlds, our world, and one true star make up the solar system. What is the solar system? What are the other worlds in our solar system? Is there life on any of those worlds? What is the star that's in our solar system?

In this book, you'll learn the answers to those questions. You'll find out other things about the solar system. And you'll see photographs that were taken in space.

Turn the page. And begin your space trip.

Unit 1

What's Your Space Address?

Suppose someone asks: "Where do you live?"

You'd probably say your house number, the name of your street, and the name of your town or city.

But you also have a space address. You live on a **planet**. That planet is in a star system. And that star system is in a certain group of stars.

- What planet do you live on?
- What star system is your planet in?
- What group of stars is your star system in?

You'll learn the answers in this unit.

Before You Start

You'll be using the science words below. Find out what they mean. Look them up in the Glossary that's at the back of this book. On the lines below, write what the words mean.

1. **galaxy** _____

_____

2. **star** _____

_____

3. **star system** _____

_____

Coming Home

You are traveling home to Earth from outer space.

You're in a spaceship. You're far away from the huge group of stars that you live in. The space around you is almost completely black. Why do you think the space is almost completely black?

_____

_____

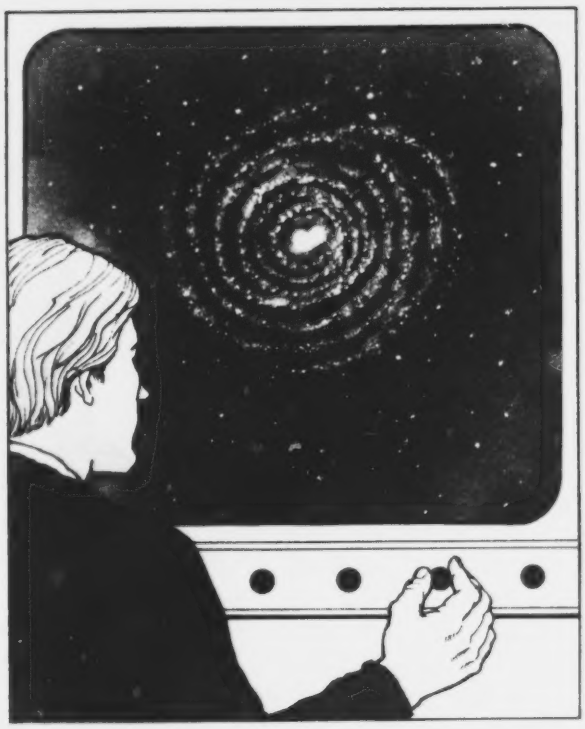
Right! The nearest star, or sun, is far away. Its light can't reach you.

Your ship is heading toward a dim light far in the distance. That light is shaped something like a circle.

As you get closer to the light, you see that it's made up of billions and billions of stars. Those stars make up your home galaxy—the group of stars you live in.

Do you know the name of your galaxy? If you do, write it here.

_____



Galaxy Ahead!

The galaxy we live in is the *Milky Way*. Look at the picture above. It shows what the Milky Way might look like from your spaceship. What does it look like to you?

From space, the Milky Way Galaxy looks like a giant whirlpool of stars.

But from Earth, the Milky Way looks like a huge, white path of stars. That's because we can only see part of the Milky Way from Earth. We can see it only at night.

Why do you think people gave this path the name *Milky Way*?

Look at the sky tonight. See if you can find the path that we call the Milky Way. You'll see part of the galaxy you live in.

Star Ahead!

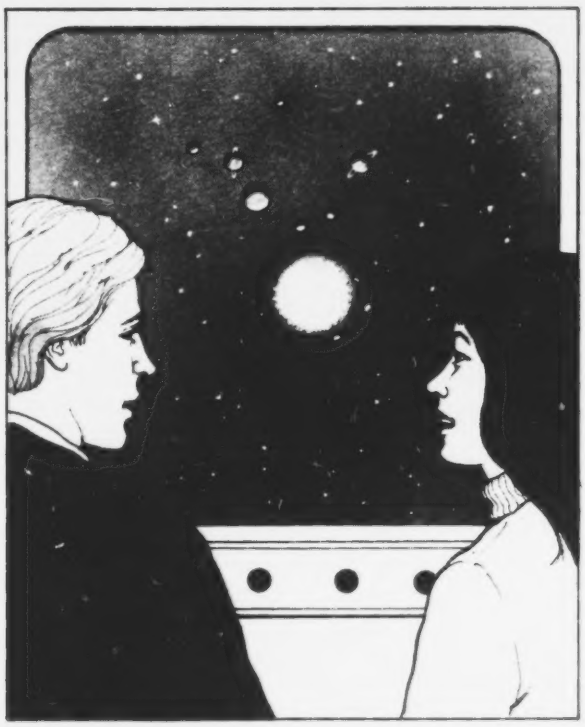
Imagine that your spaceship is now in the Milky Way. You are looking for a certain star at the edge of the Milky Way. What star do you think you're looking for?

You're looking for our sun. Our sun is a star—a **true star**. It is just one of billions of true stars in the Milky Way.

True stars are huge balls of superhot, burning gases. They give off light and heat that can be seen and felt millions of miles away.

When you look at the sky, you'll now know this: Some of the things that look like stars are *not* stars. What do you think they are?

They are worlds — or *planets*.



Star System Ahead!

Your spaceship gets closer to our sun. You see this: nine planets close to a huge, superhot, burning ball. What you're seeing is our star system.

The main parts of our star system are the sun and the planets that stay close to it. What's the name of our star system?

_____

Yes. Our star system is called the **solar system**.

There are many star systems in the Milky Way. Some may have more planets than ours. Some may have less. Some may even have planets like Earth where things can live.

Do you think there's life like ours in another star system? Why or why not?

_____

Home!

Your space trip is ending! You're heading toward a blue and white planet. A small white moon hangs above that planet.

You are looking at Earth, the third planet from the sun. You are *home*.

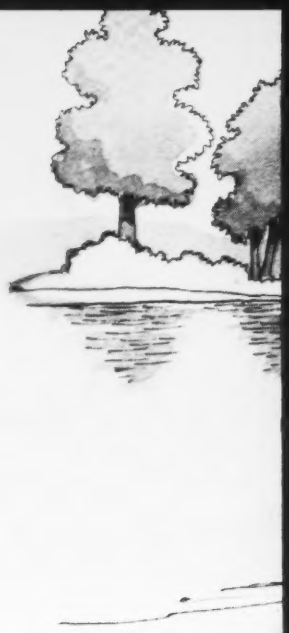
Your Space Address

Now, write your space address. First, write the name of your planet. Next, write the name of the star system your planet is in. Then write the name of the galaxy your planet is in.

Planet: _____

Star system: _____

Galaxy: _____



Check Yourself

Show what you learned in this unit. Finish these sentences. The words you'll need are listed below. One word will be left over.

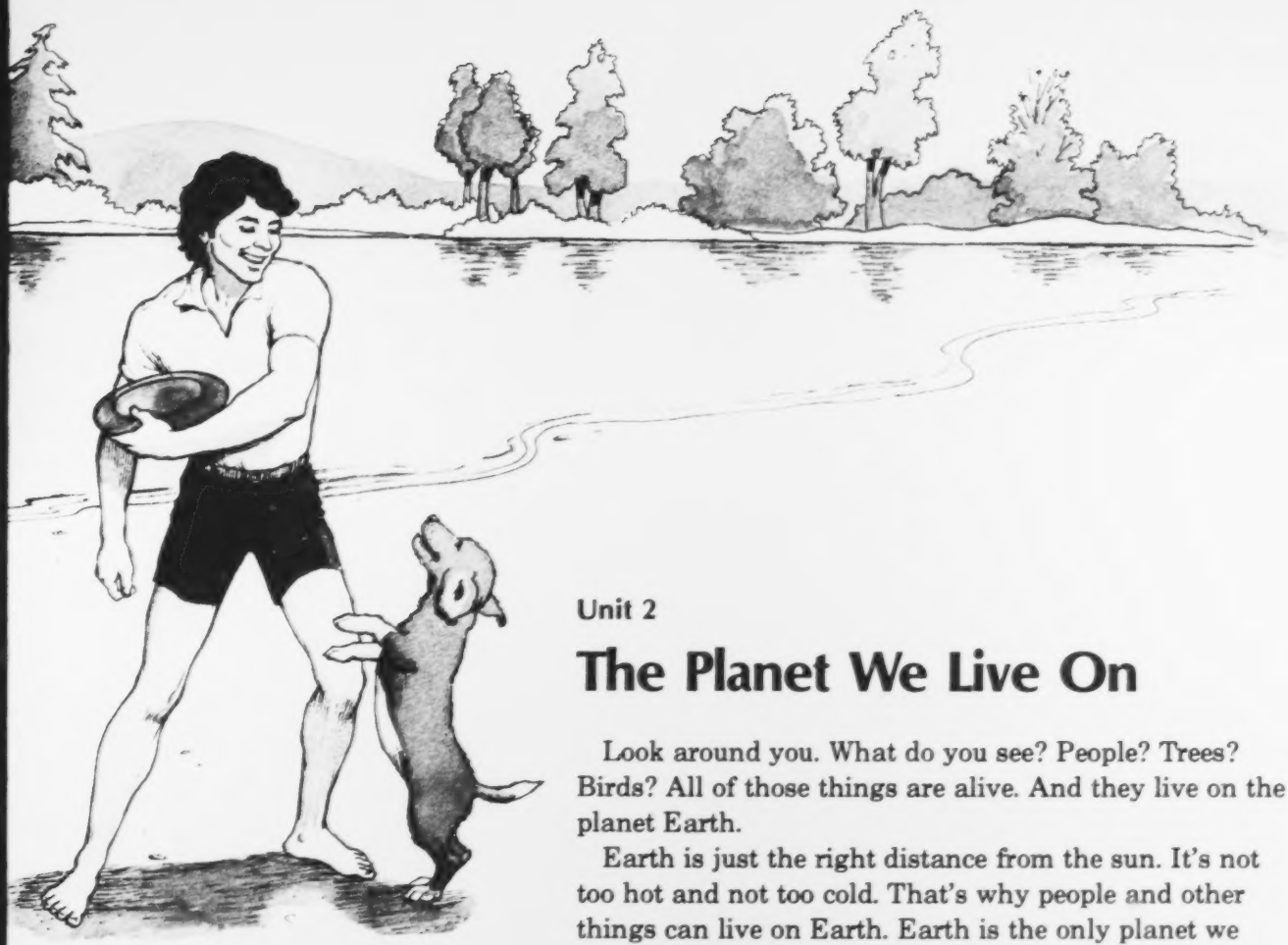
galaxy	Milky Way	Earth
star	solar	planet

1. A large group of stars is called a _____.
2. Our sun is a true _____.
3. Our sun and nine planets are parts of the _____ system.
4. The planet _____ is part of the solar system.
5. Our galaxy is called the _____ _____.

Check These Out

1. Find out about stars. How are they born? How can we tell how old they are? And how do they die? Tell your class what you find out.
2. Do this one night: Pick a star that's above a tree or a building. Draw a picture of the star and the tree or building. A month later, stand in the same spot. Look for that star and tree or building. Draw another picture of the star and the tree or building. Is the star in the same place, or has it moved?
3. Make a poster of the sun, Earth, and moon. Show how they look together in space. Color your poster.
4. As you work through this book, you may want to find out more about the solar system. You can find out more by looking in an encyclopedia or by getting books about the solar system from a library. You can also talk to an expert, such as an astronomer or an astronaut.

   Here are some things you may want to find out:
   - What is the universe? What is a constellation?
   - What is a black hole?
   - What are quasars and pulsars?
   - What is astronomy? What is astrology?



Unit 2

The Planet We Live On

Look around you. What do you see? People? Trees? Birds? All of those things are alive. And they live on the planet Earth.

Earth is just the right distance from the sun. It's not too hot and not too cold. That's why people and other things can live on Earth. Earth is the only planet we know of that has life.

- What is our planet like?
- Why don't things on Earth fall into space?
- Why does Earth have night and day?

You'll learn the answers in this unit.

Before You Start

You'll be using the science words below. Find out what they mean. Look them up in the Glossary. On the lines below, write what the words mean.

1. **axis** _____

_____

2. **gravity** _____

_____

3. **rotate** _____

_____

NASA photograph

Planet Earth in space

Planet Earth

This photograph shows what Earth looks like from a spaceship. The photograph was taken by a **NASA** spaceship as it traveled to the moon. (NASA is our country's program to explore space.)

What does Earth look like?

_____

_____

If you were on that NASA spaceship, you'd see this: a huge blue and white ball. The blue parts are the oceans that are on Earth. What do you think the white parts are?

_____

Right! The white parts are clouds. The clouds are part of Earth's **atmosphere**. (The atmosphere is the air that covers Earth.)

Earth is not perfectly round. The parts we call the "top" and the "bottom" are a little flat. The top part always points north, so we call it the North Pole. The bottom part always points south. What do you think it's called?

_____

Sticking to Earth

Toss a ball in the air. What happens to it?

Jump up. What happens to you?

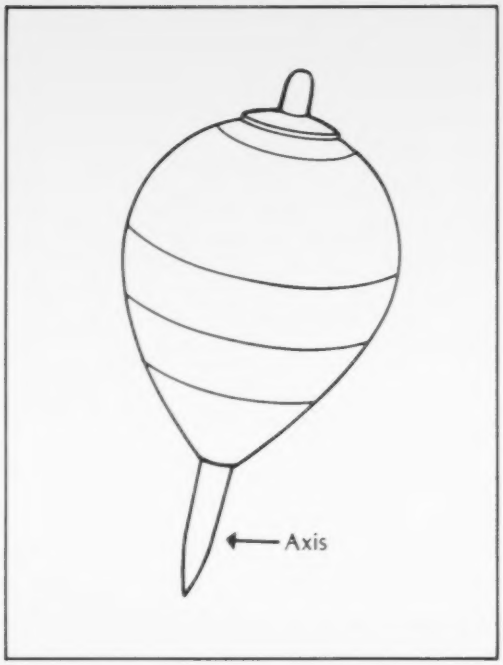
Both you and the ball land on the ground. Now toss a light thing, such as a feather, in the air. What happens to that thing?

No matter how heavy or light something is, it will always fall to the ground. What makes things fall down instead of staying up in the air?

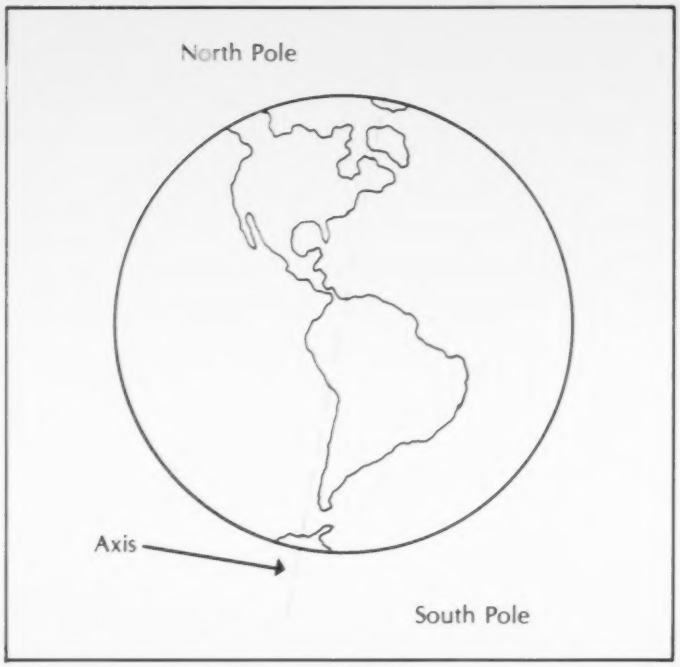
Right! Gravity.

Gravity is the strong pull that holds everything and everyone to Earth. For example, gravity holds our atmosphere close to Earth. Gravity keeps that atmosphere from flying off into space.

What do you think would happen to you if Earth didn't have gravity?



Top



Earth

Earth Spins

Right now, our planet is moving. Do you feel it moving? Do you see it moving? Probably not. But earth *is* moving.

How do you think Earth is moving?

_____

_____

One way that Earth moves is to *rotate*. In other words, it spins.

How does Earth spin? Imagine that there's a line through the center of Earth. And the line goes from the North Pole to the South Pole. That imaginary line is called an *axis*. Earth spins around that axis.

You can see how Earth rotates by spinning a top like the one in the picture. The top has a stick in the middle. When you spin the top, it rotates around the stick. Earth rotates around its axis like that.

Now look at the pictures of the top and of Earth. Is the stick in the top pointing straight up? No. The stick **tilts**.

Is the axis of Earth pointing straight up or does it tilt?

_____

Make a Model

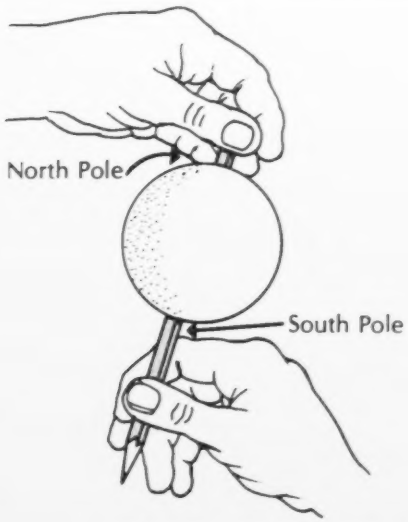
Make a model of Earth. Then make that model rotate around its axis. Here's how:

1

Get a sharp pencil and a Styrofoam ball. Carefully push the pencil through the center of the ball. Push the pencil so it comes out at the opposite end of the ball. The ball is like Earth. What is the pencil like?

_____

The pencil is like Earth's axis.



2

Hold the pencil so the eraser is pointing up. What is the top of your model Earth like?

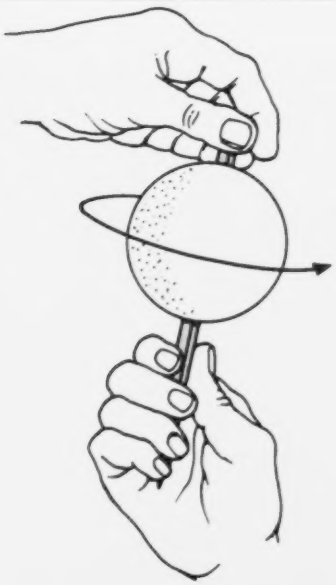
_____

Right, it's like the North Pole. And the bottom is like the South Pole.

Tilt the pencil the way it's shown in the picture. Why would you tilt the pencil?

_____

You tilt the pencil because Earth's axis tilts.



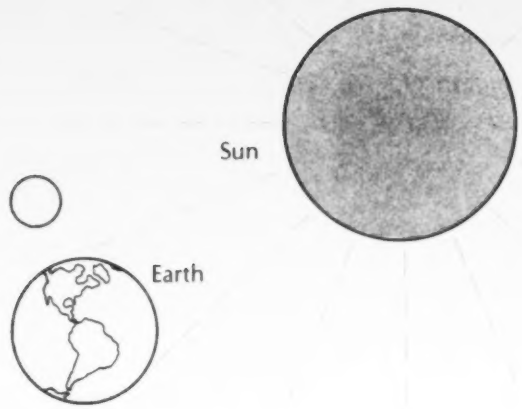
3

Hold the top of the pencil loosely with one hand. Then with your other hand, slowly turn the pencil to the right. What happens to your model Earth?

_____

_____

It rotates. Your model rotates just as Earth rotates on its axis.



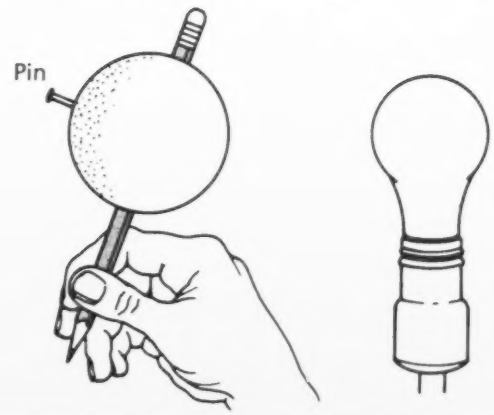
Night and Day

The picture at the top shows Earth and the sun. One side of Earth faces the sun. The sun shines on that side. That side is in day.

Look at the side that faces *away* from the sun. The sun can't shine on that side. Is that side in night or day?

_____

You can see how night turns into day. Use your model of Earth and a lamp. The lamp will be the sun.



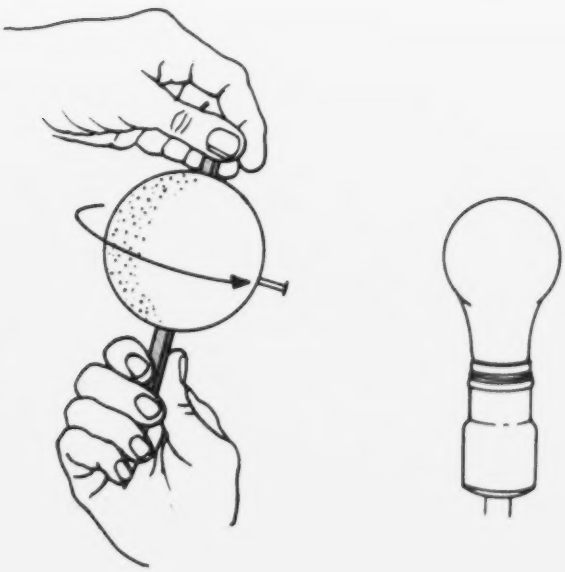
1

First, put a pin in the model. Then, turn on the lamp.

Hold your model of Earth the way it's shown in the picture. The side with the pin faces away from the lamp (your sun).

Is that side in night or day?

_____



2

Slowly rotate the model to the right. Stop when the pin faces the lamp. Is that side now in night or day?

_____

Now rotate the model until the pin faces away from the lamp. Is that side in night or day?

_____

Your model completely rotated. The pin went from night to day to night again.

How many hours do you think it takes Earth to completely rotate?

_____

Check Yourself

Use words from this unit to do the crossword puzzle. The words you'll need are listed below. The first one is done for you.

axis	Earth	atmosphere
rotate	gravity	South Pole
day	North Pole	night

Across

2. The planet we live on
5. Air that covers Earth
7. When Earth faces away from the sun
8. When Earth faces the sun

Down

1. The "top" of Earth
3. To spin
4. The strong pull from the center of Earth
5. The imaginary line through the center of Earth
6. The "bottom" of Earth

Check These Out

1. There are many stories about how Earth began. Some are old folktales. Tell about that story in whatever way you choose. For example, you can act out the story.
2. Do you know you can have a birthday two days in a row? Find out about the International Date Line. And you'll see how that can happen.
3. You learned that Earth is round. But some people believe Earth is flat. How would you explain to them that Earth *is* round.
4. Here are more things you may want to find out:
   - Who was Isaac Newton? What ideas did he give to science?
   - What is the summer solstice? What is the winter solstice?
   - What is the spring equinox? What is the autumn equinox?
   - When it's 6 a.m. in New York, it's 12 noon in Paris, 8 p.m. in Japan, and so on. Why is the time different in different places?

Unit 3

Our Moon

Did you ever go fishing at night when the moon was full? Remember how bright the moon was? It was so bright, you didn't need a flashlight. Where did the light come from?

Right! It came from the moon. The moon is a planet, like Earth is. But the moon shines, and it doesn't always look round.

- Why does the moon shine?
- Why does the moon seem to change its shape?
- How does the moon move?

You'll learn the answers in this unit.

Before You Start

You'll be using the science words below. Find out what they mean. Look them up in the Glossary. On the lines below, write what the words mean.

1. **reflect** _____

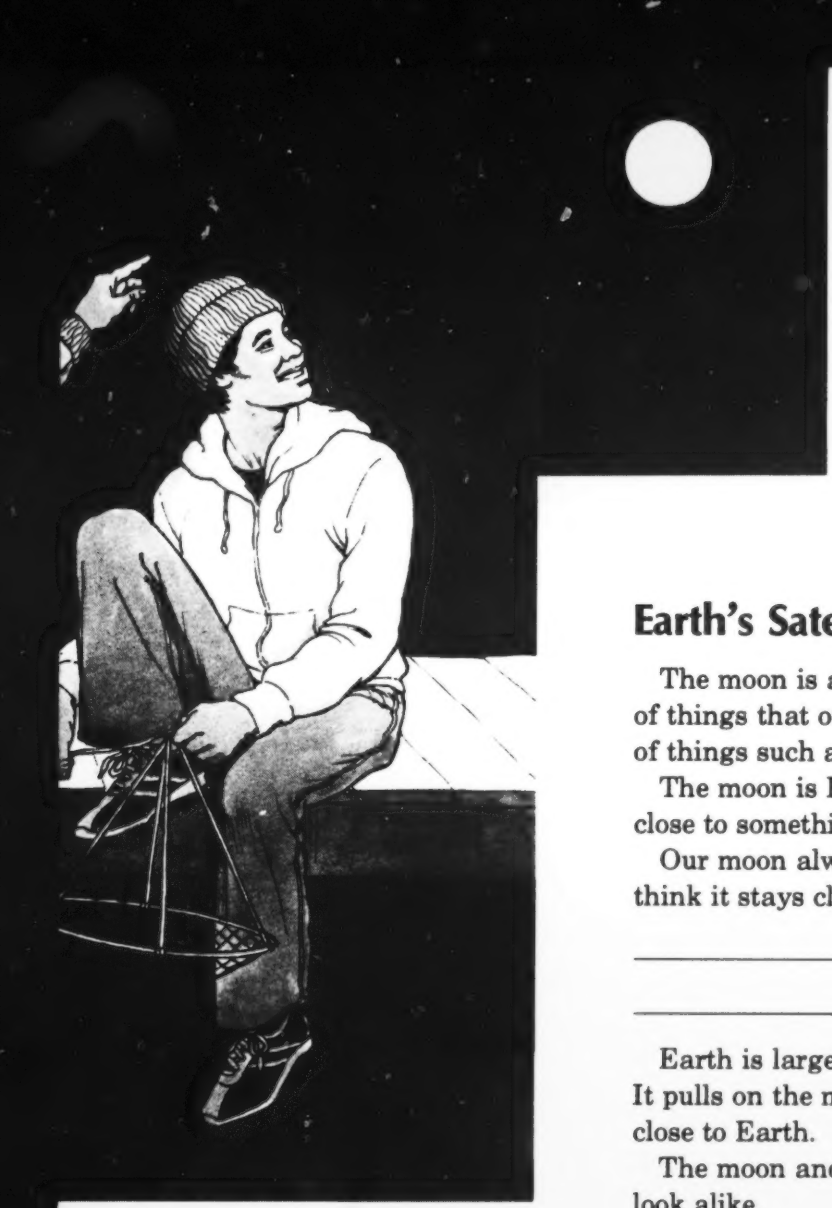
_____

2. **revolve** _____

_____

3. **satellite** _____

_____



Earth's Satellite

The moon is a small planet. It's made of the same kinds of things that our planet is made of. (Planets are made of things such as rock and metals.)

The moon is Earth's satellite. A satellite always stays close to something that's larger than it.

Our moon always stays close to Earth. Why do you think it stays close to Earth?

_____

_____

Earth is larger than the moon. Earth's gravity is strong. It pulls on the moon. So, Earth's gravity keeps the moon close to Earth.

The moon and Earth are both planets. But they don't look alike.

Earth has oceans full of water. The moon has no water on it.

Earth has an atmosphere around it. The moon has no atmosphere at all.

Imagine that you are on the moon. What would the moon look like? Describe what you think you'd see.

_____

_____

_____

_____

_____

_____

Moonshine

You learned that the moon is a planet, as Earth is. But the moon shines. Where does its light come from? Look at the picture at the top of the page. Write where the moon's light comes from.

Yes, the moon's light comes from the sun. The sun lights up the moon. You can see how the sun lights up the moon. Get a globe of the world. Get a lamp. It should be taller than the globe. Now, make a model of the moon with a ball and a pencil.

1

Put the globe about a foot away from the lamp. Turn on the lamp. Turn off all other lights in the room.

2

Hold your model above the globe. Look at that model. What happens to it?

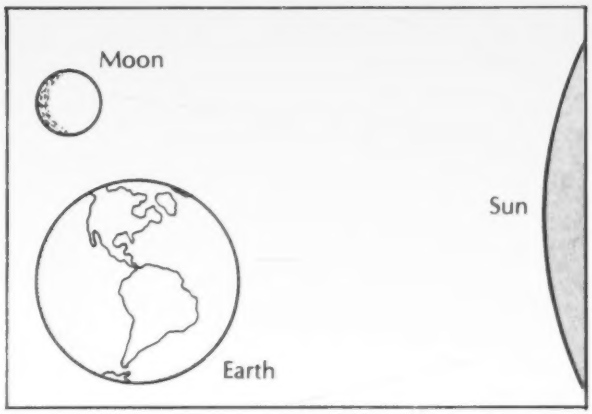
Yes! One part of your model is lit up. It's lit up by the lamp.

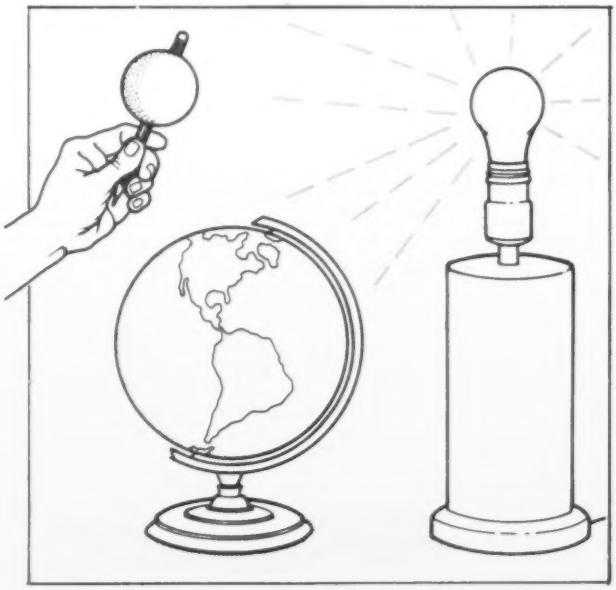
That's what happens to the moon. The sun shines on it and lights it up. We see the moon at night because the sun lights it up.

The moon is like a dull mirror. It reflects the sun's light. And that light comes to Earth.

All planets reflect the sun's light. Suppose you were on the moon. What would Earth look like in the sky?

Right! Earth would shine and reflect the sun's light. Earth would shine like the moon!





Does the Moon Have Gravity?

Picture this: You're in a spaceship that just landed on the moon. You're about to step out of that spaceship. Can you walk on the moon? Or will you fly off into space?

Right. You can walk on the moon.

The moon has gravity. Its gravity will pull on you, so you won't fly off into space.

But as you walk on the moon, you'll feel lighter. That's because the moon's gravity is weaker than Earth's.

You learned that the moon has no atmosphere. Why do you think it has no atmosphere?

Right! The moon has no atmosphere because its gravity is weak. Its gravity is too weak to hold an atmosphere around the moon.

Even though the moon's gravity is weak, it pulls on Earth. For example, it pulls on Earth's oceans.

What happens to our oceans when the moon's gravity pulls on them?

The Moon Moves

You learned that the moon is a satellite. And that satellites stay close to a larger thing.

Satellites are always moving. They move around the thing that they stay close to. They *revolve* around it.

What does the moon revolve around?

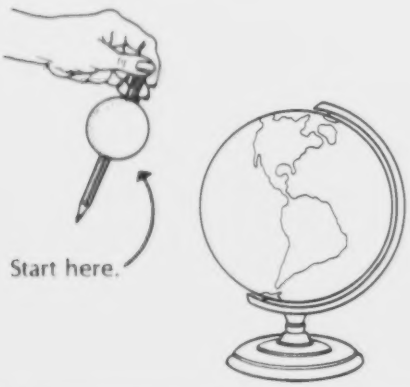
_____

Right! The moon revolves around Earth. Find out how.

Get your model of the moon. Get a globe of the world.

1

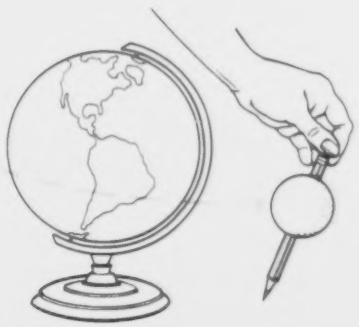
Hold the model to your left and above the globe.



2

Now move the model toward your right.

X



3

Move the model around the globe in one direction.

X

4

Move the model back to where you started.

Changing Shapes

The moon is round, but it doesn't always look round to us. Its shape seems to change. Why do you think that happens?

Its shape seems to change because the moon revolves around Earth.

Suppose the sun is behind the moon. The side of the moon that faces the sun is lit by the sun. We can't see that side because it faces away from Earth.

The side that faces Earth is in darkness. We can't see that side either. We say the moon then is a *new moon*. (See picture **A**.)

As the moon revolves around Earth, it moves away from the sun. We start seeing the side that's lit by the sun. We see more of it as the moon revolves. Soon we can see half of the side. We then say the moon is a *quarter moon*. (See picture **B**.)

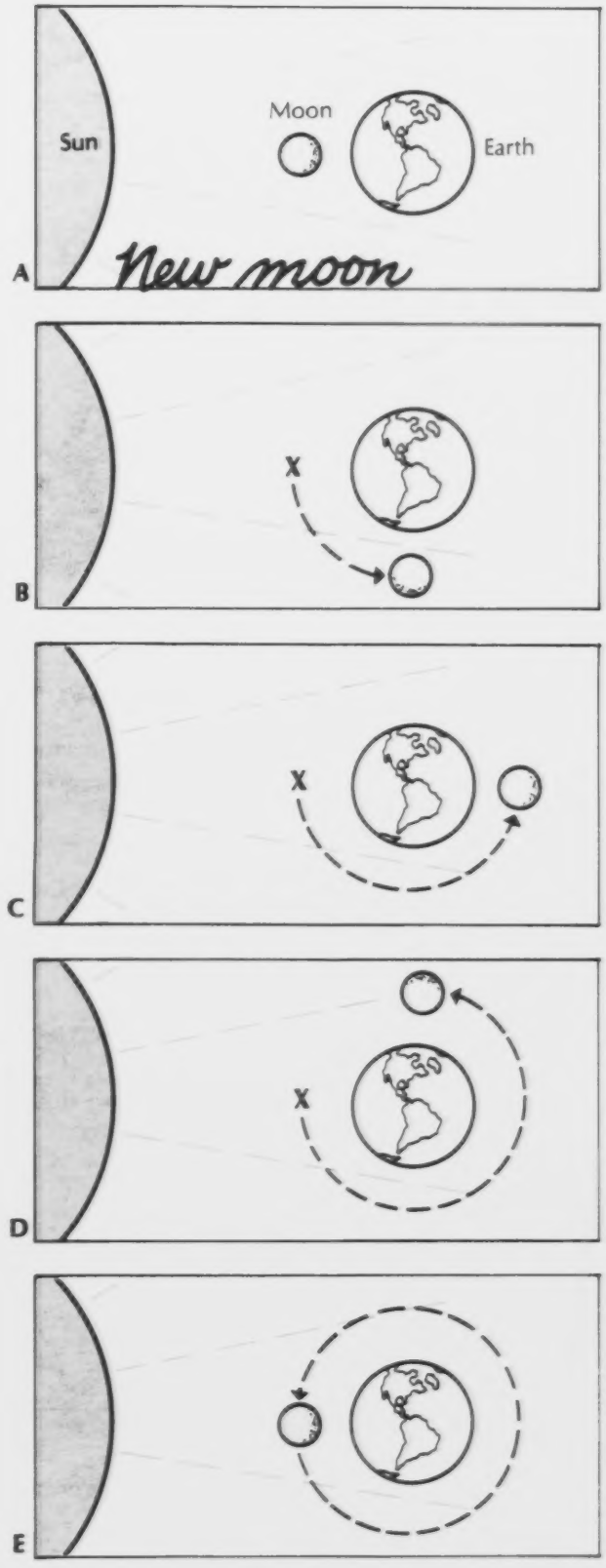
When the moon is halfway around Earth, we can see all of the side that's lit. The moon's shape is now round. We call that moon a *full moon*. (See picture **C**.)

Now the moon starts moving back toward the sun. We see less and less of the side that's lit. Soon, we see only half of it. (See picture **D**.) What do we call the moon then?

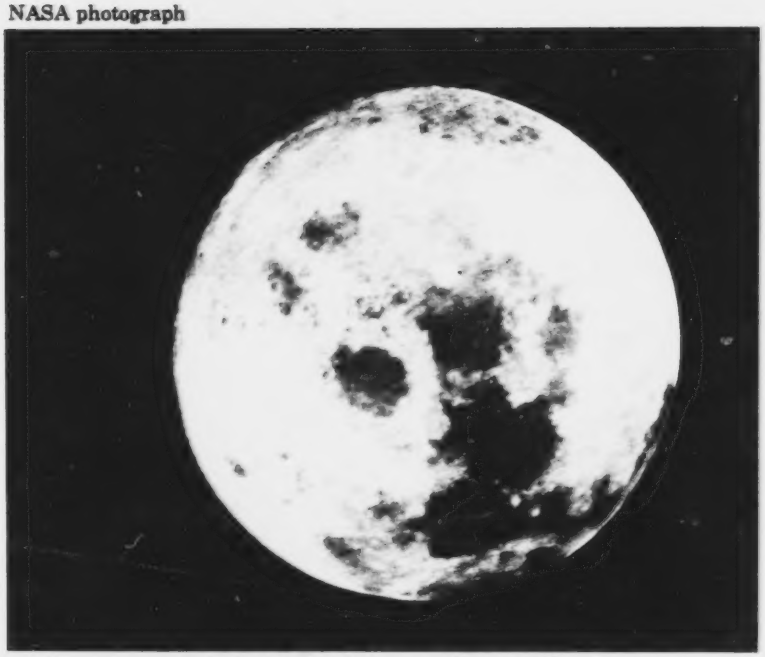
Right! A quarter moon.

When the moon completely revolves around Earth, the sun is behind the moon again. (See picture **E**.) What is the moon called now?

Look at the pictures on this page. On each picture, write *full moon, new moon*, or *quarter moon*.



NASA photograph



This side of the moon faces Earth.

Another Way the Moon Moves

Do you know this? The same side of the moon always faces Earth. Why do you think this happens?

Find out why the same side of the moon always faces Earth.

Put a chair in the middle of a room. Face the front side of your body to the chair.

Now, slowly walk around that chair. As you walk, keep the front of your body facing the chair.

What do you have to do to your body so that it always faces the chair?

Right! You have to keep turning your body so that it always faces the chair. You have to rotate your body.

Now, think about the moon. What does it do so that the same side always faces Earth?

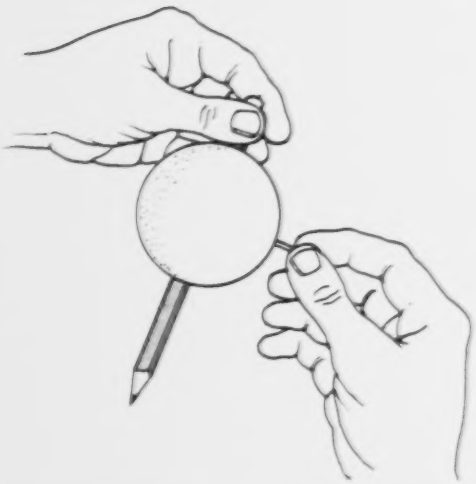
Right! The moon rotates.

What would happen if the moon didn't rotate?

The Moon Rotates and Revolves

You learned that the moon rotates. And you learned that the moon also revolves. The moon rotates *as* it revolves around Earth.

Find out how the moon rotates as it revolves. Get your model of the moon. Get a globe of the world.

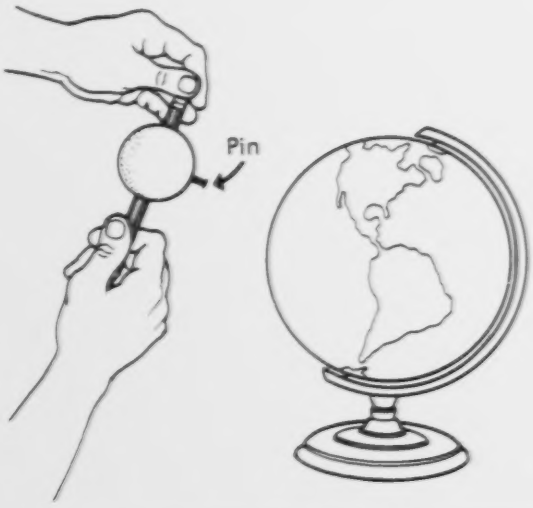


1

Put a pin in the model of the moon. That side with the pin will stand for the side of the moon that always faces Earth.

2

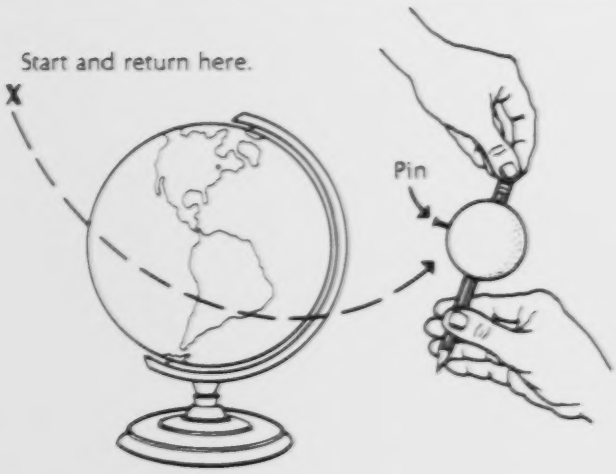
Hold the model to your left above the globe. Then, move your model to your right. Revolve your model around the globe.



3

As you revolve your model do this: Very slowly rotate the model so the pin always faces the globe.

That's how the moon rotates as it revolves around Earth.



You learned that Earth also rotates. Earth takes 24 hours to completely rotate. (24 hours is a day and a night.)

How long do you think it takes for the moon to completely rotate?

_____

Check Yourself

Show what you learned in this unit. Finish these sentences. Draw a line from the words on the left to the correct words on the right.

1. The moon is	a. weaker than Earth's gravity.
2. The moon shines because	b. it reflects the sun's light.
3. The moon's gravity is	c. Earth's satellite.
4. Earth's gravity holds the	d. shape seems to change.
5. The moon rotates as it	e. moon close to Earth.
6. As the moon revolves, its	f. revolves around Earth.

Check These Out

1. How many days does the moon take to completely rotate? How many days does the moon take to revolve around Earth? Find out.
2. Find out about the phases of the moon. Then get a calendar that shows when each phase begins.

   Look at the moon for one month. Draw the moon each time it begins a new phase. Write the date when you see each phase begin.
3. Many songs are about the moon. Find as many as you can. Bring some of those songs to your class.
4. Here are more things you may want to find out:
   - What does *lunar* mean?
   - What is a moon eclipse? What causes it?
   - How do scientists think the moon began?

Unit 4

Our Sun

Imagine that it's raining right now. And that it's been raining for days. You think it'll never end. You feel low.

Then the sun comes out. Now you feel great!

The sun can make you feel good. But it does more than give good feelings. The sun gives Earth the things we need to live.

- What does the sun give to Earth?
- Why does Earth stay close to the sun?
- How does Earth move in space?

You'll learn the answers in this unit.

Before You Start

You'll be using the science words below. Find out what they mean. Look them up in the Glossary. On the lines below, write what the words mean.

1. **ellipse** _____

_____

2. **orbit** _____

_____

3. **seasons** _____

_____

Sol

The sun is shaped like a ball. Earth and the moon are also shaped like balls. But the sun is different from Earth and the moon. How is it different?

Right! The sun is a true star. Earth and the moon are planets.

True stars are made of superhot, burning gases. So, the sun is a huge ball of superhot, burning gases. It is the biggest thing in the solar system. And it is in the center of the solar system.

Why do you think the sun is important to Earth?

If we didn't have the sun, nothing would be alive on Earth. The sun gives light and heat that living things need.

But things can't live unless a planet gets the right amounts of light and heat. Earth gets just the right amounts. Why do you think Earth gets the right amounts?

Yes! Earth is just the right distance from the sun.

People have always been interested in the sun. They have called it by many names. One of these names is **Sol**. You've seen these words: *solar system* and *solar energy*. What do you think *solar* means?

This picture shows the size of the sun. The small planet next to the sun is Earth.

Our Giant Sun

Suppose you could put all the planets in the solar system together. Which would be bigger? Those planets or the sun?

The sun!

The picture on this page shows the sun with Earth next to it. It gives you an idea of how big the sun is.

Here's another way to think about how big the sun is. Get a basketball. Get a piece of bread (or modeling clay). Roll the bread (or clay) into a tiny ball this big: ◔ Put that tiny ball next to the basketball.

Look at the sizes of the basketball and the tiny ball. See how big the basketball is next to the tiny ball? That's how big the sun is next to Earth.

Suppose you put a grain of sand next to the tiny ball and the basketball. What do you think that grain of sand shows?

Yes. It shows how small the moon is next to Earth and the sun.

Earth and the other planets stay around the sun. Why do you think they do?

Right! The sun has gravity.

It has the strongest gravity in the solar system. So, it's the sun's gravity that keeps the planets around the sun.

Moving around the Sun

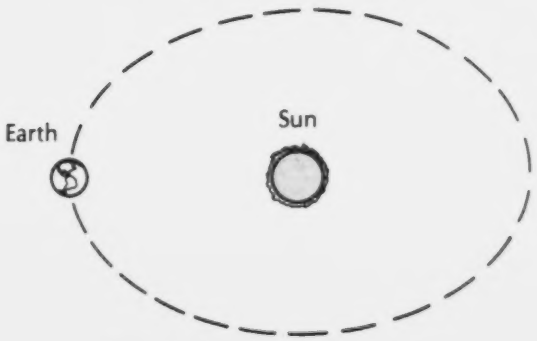
You learned that Earth rotates. What other way do you think Earth moves?

Earth *revolves*. It revolves around the sun.

Look at the picture below. The dotted line shows Earth's path around the sun. That path is called an *orbit*.

Look at the shape of Earth's orbit. It's like a flat circle. That shape is an *ellipse*.

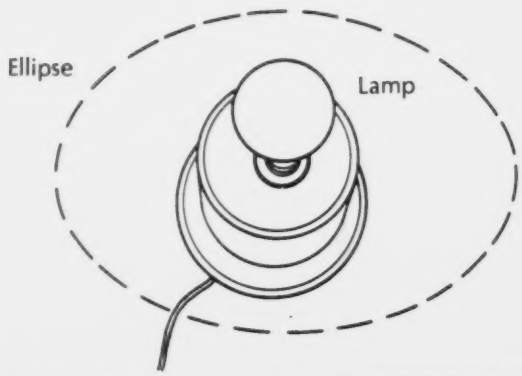
Find out how Earth revolves.



How Earth moves around the sun

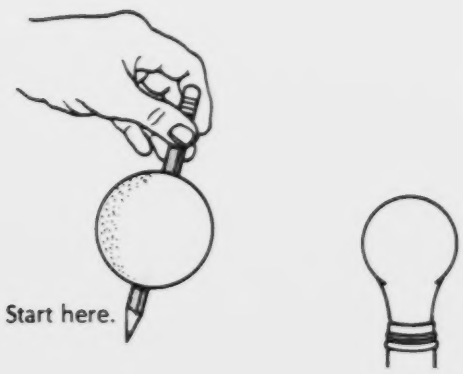
1

Get your model of Earth. Get a lamp. Set the lamp on a table. The lamp will stand for the sun. Look down at the top of the lamp. Imagine that there's an ellipse around the lamp.



2

Hold your model of Earth the way it is shown in the picture.

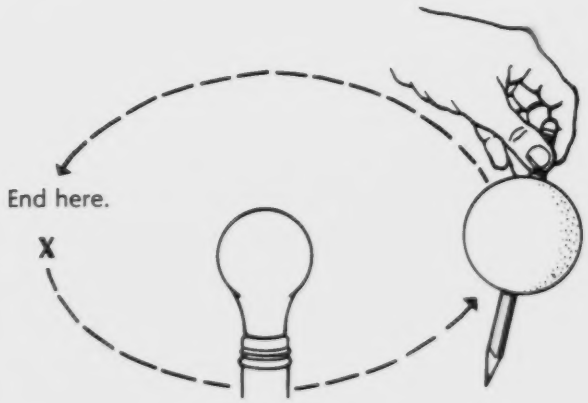


3

Move your model completely around the lamp in an ellipse. That's how Earth revolves around the sun.

How long do you think it takes Earth to revolve around the sun?

Did you say, "One year"? You're right.



Changing Seasons

Earth has four seasons: summer, fall, winter, and spring. These seasons are always changing.

Summer changes into fall. Fall changes into winter. And winter changes into spring. What does spring change into?

Right! Spring changes into summer.

Why do you think seasons change? Here's why: Earth tilts. And Earth revolves around the sun. As Earth revolves, the seasons change.

Look at picture **A**. It shows Earth when it's summer in the United States.

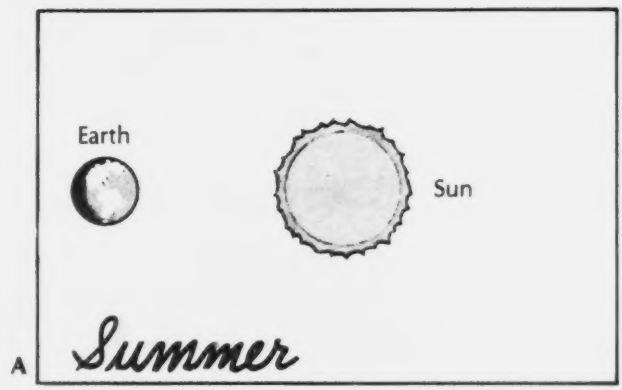
Now look at picture **B**. Notice where Earth moves to. It is now fall in the United States.

Look at picture **C**. Earth is halfway around the sun. What season is it now in the United States?

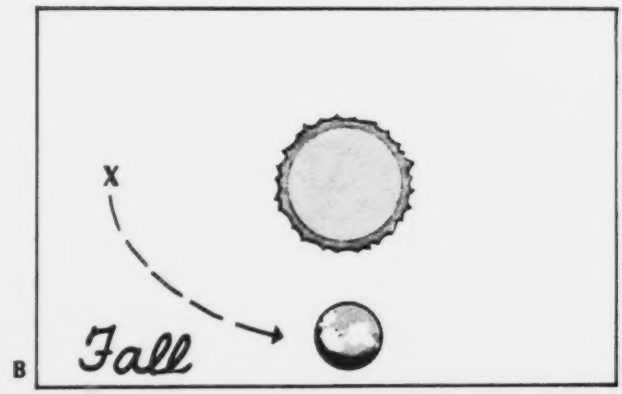
Right! Winter. Write the name of that season on picture **C**.

Picture **D** shows Earth as it almost completes its trip around the sun. What season is it now in the United States?

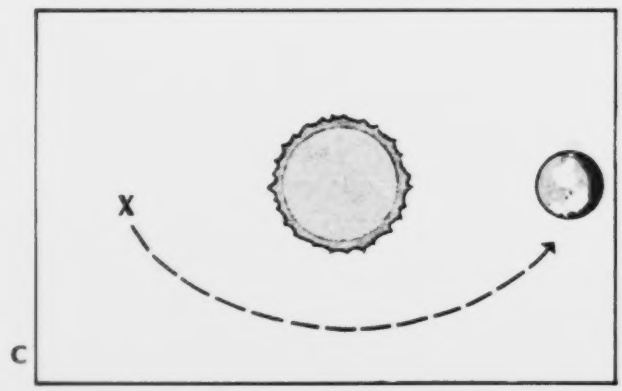
Write the name of the season on picture **D**.



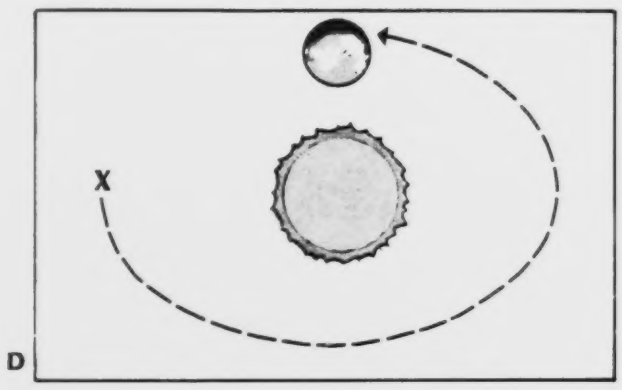
A



B



C

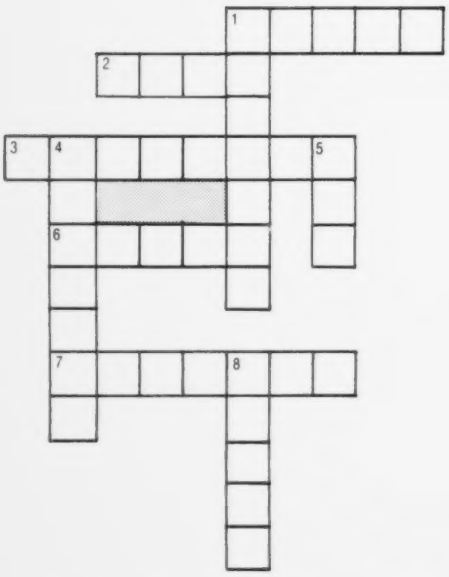


D

Check Yourself

Use words from this unit to do the crossword puzzle. The words you'll need are listed below.

ellipse	light	seasons
gases	orbit	Sol
gravity	revolves	star



Across

1. The sun is made of superhot, burning _____.
2. Our sun is a true _____.
3. Earth _____ around the sun.
6. The sun gives Earth _____ and heat.
7. Winter, spring, summer, and fall are _____.

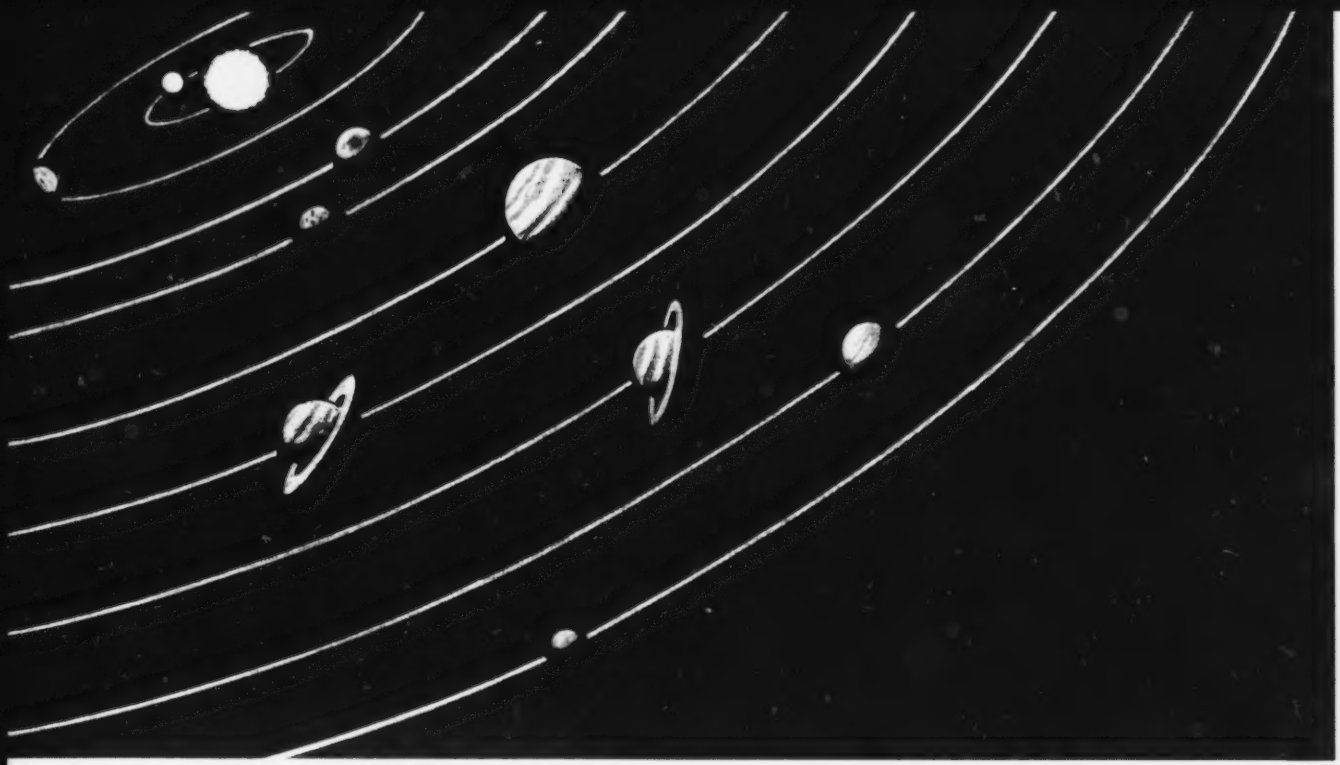
Down

1. The sun's _____ keeps Earth around it.
4. Earth's path is in the shape of an _____.
5. _____ is one name for our sun.
8. Earth revolves around the sun in an _____.

Check These Out

1. When it's summer in the United States, it's winter in Australia. Find out why. Then use the model of Earth and a lamp to show what you learn.
2. What is *solar energy*? How do people use solar energy? What are new ways that this energy can be used? Find out. Then make a poster showing different ways to use solar energy.
3. Get a partner. Together, find out the answers to these questions:
   - What's the sun made of?
   - How hot is the sun?
   - Why does the sun always stay hot?
   - How was the sun born?
   - Will our sun ever die?

   Now make up a short play about the sun. Pretend the sun is a person. Pretend a TV reporter is asking the sun questions about its life.
4. Here are more things you may want to find out:
   - How far is the sun from Earth?
   - What is a light year?
   - How do scientists think life began on Earth?
   - What is a solar eclipse? How is it different from a lunar eclipse?



Unit 5

Our Solar System

You learned that the sun is the biggest thing in the solar system. And that there are planets, such as Earth, around the sun. But there are many other things around the sun. The sun and all the things around it make up the solar system.

You learned that Earth is always moving. The other things in the solar system are always moving, too.

- What are some of the things in our solar system?
- How do those things move?

You'll learn the answers in this unit.

Before You Start

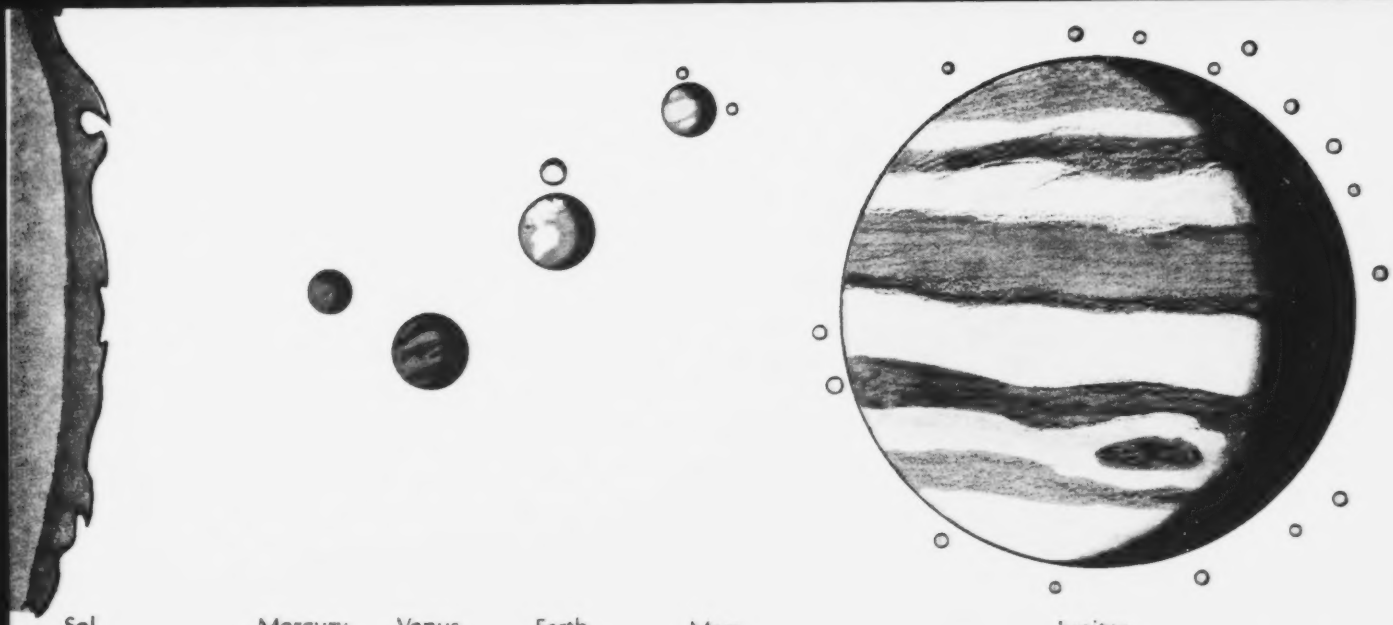
You'll be using the science words below. Find out what they mean. Look them up in the Glossary. On the lines below, write what the words mean.

1. **collide** _____

_____

2. **object** _____

_____



Sol's Planets

Our solar system is made up of the sun and everything that's around the sun. You already know what some of those things are. They are planets.

Scientists know of nine planets in our solar system. The picture above shows the nine planets. It shows the different sizes of the planets. Which is the largest planet?

_____

Yes. Jupiter is the largest planet.

The picture also shows how far each planet is from the sun. For example, Pluto is the farthest from the sun. So, Pluto is the *ninth* planet from the sun.

What planet is Jupiter from the sun? (Count the planets, starting with Mercury. Stop when you get to Jupiter.)

_____

Right! Jupiter is the fifth planet from the sun.

Now find Earth. What planet is Earth from the sun?

_____

Look at Jupiter again. You'll see many small objects around it. What do you think those objects are?

_____

Yes. Those objects are moons.

Which planets have moons? Write the names of two of those planets.

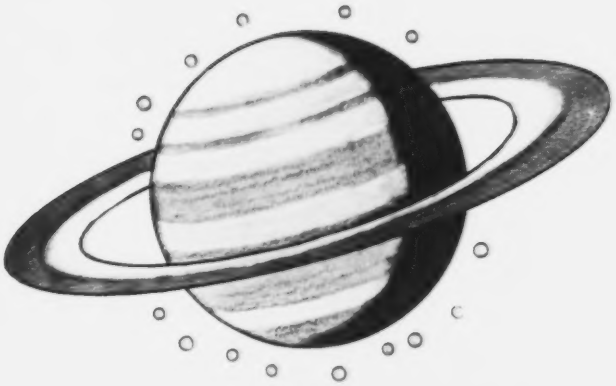
_____

_____

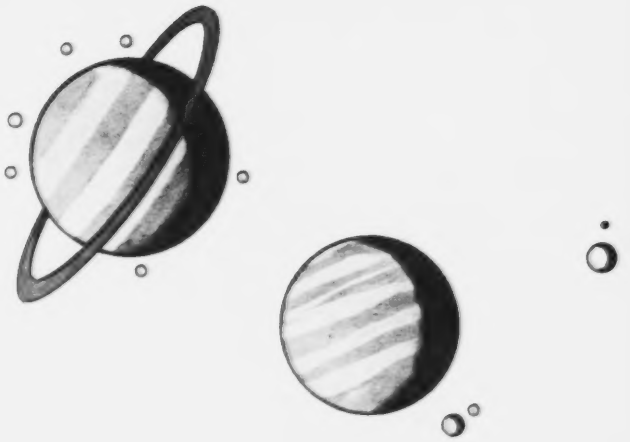
Which two planets don't have moons?

_____

_____



Saturn



Uranus Neptune Pluto

Going around in Orbits

You learned that Earth revolves around the sun in an orbit. The other planets also revolve around the sun in orbits.

The time it takes a planet to go around the sun is called that planet's year. How many days are in an Earth year?

There are about 365 days in an Earth year. That's how long it takes Earth to go around the sun.

Other planets have orbits that are longer or shorter than Earth's. Planets with shorter orbits take less time to go around the sun. Planets with longer orbits take more time.

For example, Mars's orbit is longer than Earth's. So it takes Mars longer to go around the sun. A Mars year is almost twice as long as an Earth year.

The planets move at incredible speeds. But they always stay in their orbits. Why don't they move out of their orbits?

If you're not sure, read page 27 again.

The Worlds Turn

All the planets rotate, or spin, around an axis. The time it takes a planet to completely rotate is called that planet's day. How many hours are in an Earth day?

Right! There are 24 hours in an Earth day. That's how long it takes Earth to spin completely around.

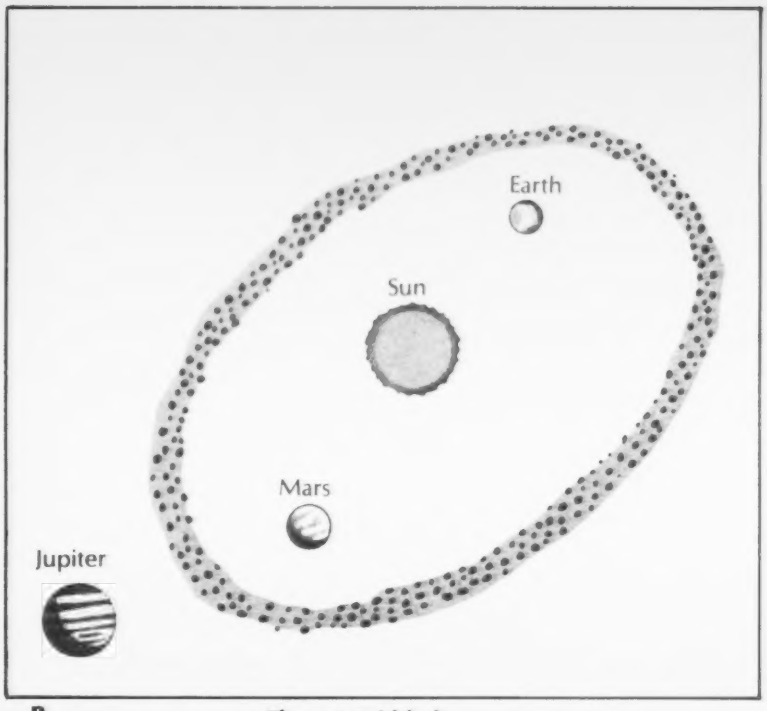
Some planets have days that are longer than 24 hours. Some planets have days that are shorter. Here's why some planets have longer or shorter days:

Planets rotate at different speeds. For example, Earth rotates faster than Pluto does. So, Earth completes a spin before Pluto does. And an Earth day is shorter than a Pluto day. A Pluto day is 154 hours long. (That's more than six Earth days.)

One Mercury day is as long as 59 Earth days—or about 1,416 hours. One Jupiter day is ten hours long. Which planet spins faster—Mercury, Jupiter, or Earth?

NASA photograph

A An asteroid



B The asteroid belt

Asteroids

You learned that there are planets around the sun. But there are other objects too. Those objects are smaller than planets. Those objects are **asteroids**, **comets**, and **meteoroids**.

Picture **A** on this page shows an asteroid. What does that asteroid look like to you?

_____

_____

Asteroids are sometimes called "little planets." They are made of the same things that planets are made of—rock and metals. Many scientists think that asteroids are pieces of old planets that broke apart.

Some asteroids look like round balls. Some look like jagged rocks. Asteroids can be the size of a mountain. Or they can be the size of tiny stones.

Do you think asteroids move? Or do they stay in the same place in space?

_____

Right! Asteroids move. They revolve around the sun, just as planets do. Each asteroid has its own orbit around the sun.

There are thousands of asteroids in our solar system. Most of them seem to be in a huge, wide ring that goes around the sun. That ring is called the *asteroid belt*. That ring is between Mars and Jupiter.

Look at picture **B**. It shows what scientists think the asteroid belt looks like. Why do you think it's called a belt?

_____

_____

NASA photograph

Comet Kohoutek

Comets

The photograph on this page shows a comet. Scientists named that comet *Kohoutek*.

How do you think a comet is like an asteroid?

_____

_____

A comet is like an asteroid in these ways: It is smaller than a planet. It has an orbit.

Comets are frozen balls of gas, dust, and rock that revolve around the sun.

As a comet moves toward the sun, the heat of the sun melts some of the comet's gases. The melted gases stream behind the moving comet and form a long tail. When that happens, the comet looks something like Kohoutek, in the picture.

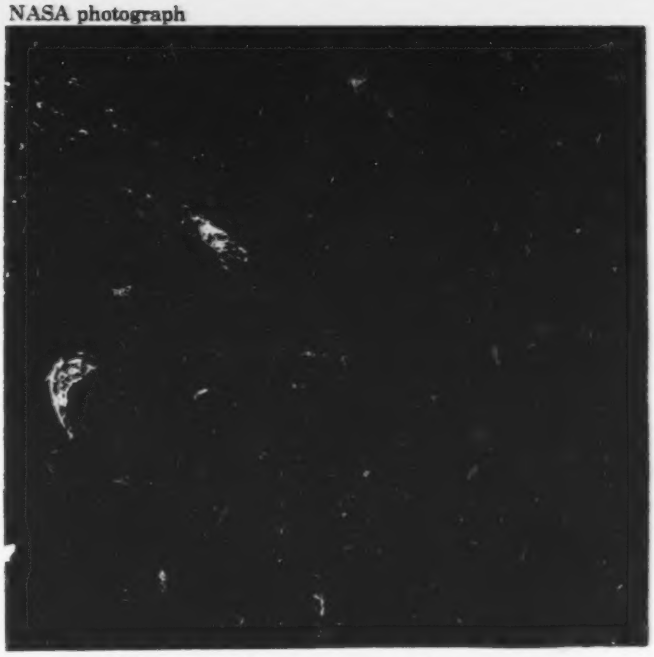
Comets have very long orbits. Some comets take thousands of Earth years to complete their orbits. Those comets have orbits that are much longer than Pluto's. (Pluto is the farthest planet from the sun. Pluto takes 248 Earth years to complete its orbit.)

Some comets take less time to complete their orbits. For example, Halley's Comet takes 76 Earth years to complete its orbit.

As Halley's Comet travels toward the sun, it passes Earth. When that happens, we can see that comet from Earth. Halley's Comet passed Earth in 1910. When does it pass Earth again? (Hint: Add 76 to 1910.)

_____

NASA photograph



What made these craters on the moon?

Meteoroids

Has this ever happened to you? You're looking at the sky. Suddenly you see a star fall. What do you think that falling star is?

_____

That falling star is *not* a star. It is a meteoroid that is burning up in our atmosphere.

Meteoroids are broken pieces of asteroids or comets. Meteoroids can be as big as rocks or as tiny as dust. There are millions of meteoroids in our solar system.

Meteoroids travel through space at very high speeds. Sometimes, they collide with planets. When that happens, they are called **meteorites**.

Look at the picture of our moon. It has often been hit by meteorites. How would you describe the moon?

_____

The moon has many **craters**. The craters show where meteorites crashed into the moon.

Meteoroids sometimes get close to Earth. But very few ever collide with Earth. That's because of Earth's atmosphere. Meteoroids travel so fast that they burn up in our atmosphere. (When that happens, they are called **meteors**.)

The moon has no atmosphere. So meteoroids don't burn up when they get close to the moon. They crash into the moon instead.

Suppose Earth had no atmosphere. What would happen when meteoroids get close to Earth?

_____

Check Yourself

Show what you learned in this unit. Finish these sentences. Draw a line from the words on the left to the correct words on the right.

1. The solar system is the sun	a. revolve around the sun.
2. Planets, asteroids, comets, and meteoroids	b. at different speeds.
3. All planets rotate	c. and all the objects around it.
4. Comets are frozen balls	d. Earth's atmosphere.
5. Meteoroids usually burn up in	e. of gas, dust, and rock.
6. Asteroids are sometimes called	f. "little planets."

Check These Out

1. With your class, make a model of the solar system. Cut out paper models of the sun and each of the nine planets. (Use the picture on pages 32 and 33 to figure out how big each model should be.) Hang the paper models from the ceiling with string.
2. Make a poster showing how far Earth and the other planets are from the sun. Find out how many miles Earth is from the Sun. Write it on the poster.
3. Find out what a meteor shower is. And find out when you might see those showers during the year.
4. Here are more things you may want to find out:
   - How did the planets get their names?
   - How do scientists think the solar system began?
   - Who was Edmund Halley? Tell about his life.

NASA photograph

Unit 6

Exploring Our Solar System

People have always wondered about the stars. At one time, people just explained about stars by making up stories. Then they began to look at the stars like scientists. And they began to find out the facts that you learned in this book.

Today, people explore our solar system in new and better ways. And we are still learning about our solar system. New discoveries are always being made. So you will always be learning new things about our solar system!

- How are we exploring our solar system today?
- What are some new discoveries about the solar system?

You'll learn the answers in this unit.

Before You Start

You'll be using the science words below. Find out what they mean. Look them up in the Glossary. On the lines below, write what the words mean.

1. **spacecraft** _____

_____

2. **space probe** _____

_____

3. **unmanned spacecraft** _____

_____

NASA photograph

A Giant Leap

"That's one small step for a man, one giant leap for mankind."

That's what **astronaut** Neil Armstrong said when he stepped on the moon in 1969. Neil Armstrong was the first person ever to be on the moon. (The first person ever to travel in space was Yuri Gagarin, a Russian astronaut. In 1961 he traveled around Earth in the spacecraft *Vostok 1.*)

Spacecraft that carry people are called manned spacecraft. So far, manned spacecraft have carried up to three people. And they can stay in space for only a short time.

So scientists send unmanned spacecraft into space. (Unmanned spacecraft have no people on them.) Those spacecraft can travel farther than manned spacecraft.

Unmanned spacecraft are sent on space probes—trips through the solar system. They carry sensitive instruments that are controlled by people on Earth. Those instruments send information about the solar system back to Earth.

The United States has sent at least 29 unmanned spacecraft on space probes. *Mariner 10, Viking 1, Voyager I,* and *Voyager II* are some of those spacecraft. They have helped us make important discoveries about the planets in our solar system.

You may have learned about one of those discoveries through TV or the newspapers. If you did, write what you learned here.

_____

_____

_____

NASA photograph

NASA photograph

Mercury

In 1974 *Mariner 10* passed close to Mercury. *Mariner 10* sent back pictures of Mercury. For the first time, scientists could see what Mercury really looks like.

The picture above is one of the pictures *Mariner 10* sent to Earth. It shows part of Mercury. How would you describe that planet?

_____

_____

_____

Mercury is like our moon in this way: It's full of craters. Those craters were made billions of years ago. What do you think made those holes on Mercury?

_____

Venus

The picture above was also sent by *Mariner 10*. It shows the planet Venus. See the white parts on the planet? What do you think they are?

_____

Right. Those white parts are clouds.

Until spacecraft visited Venus, scientists believed the clouds on that planet were like the clouds on Earth. They thought the clouds on Venus were made up of water, like the clouds on Earth. So, they thought there might be life on Venus.

Today, scientists know that the clouds on Venus aren't like Earth's clouds at all. The clouds on Venus are made up of a chemical called sulphuric acid. Scientists also found out that the temperature on Venus can reach 900 degrees.

Do you think things could live on Venus? What might those things be like?

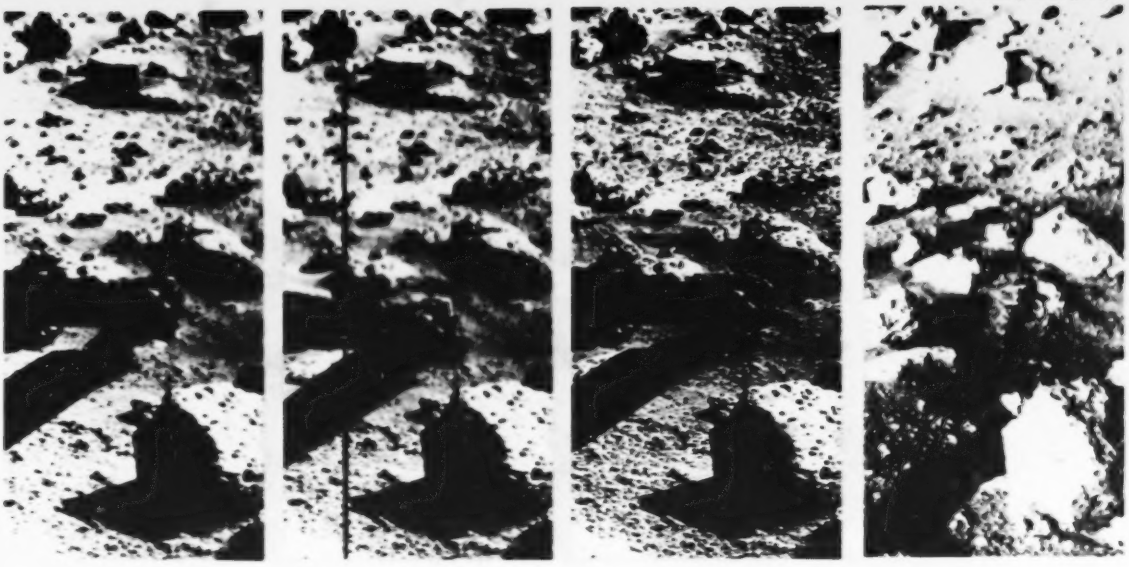
_____

_____

_____

_____

NASA photograph



Mars

Is there life on Mars? Many people think so. The picture above was taken on Mars. It was taken by the spacecraft *Viking I* in 1976.

What does Mars look like to you?

_____

_____

_____

So far, our space probes haven't found any signs of life on Mars. Scientists haven't seen anything to show that there are plants, humans, or other animals on Mars. But scientists believe that since Mars has some water, some type of life does live on it.

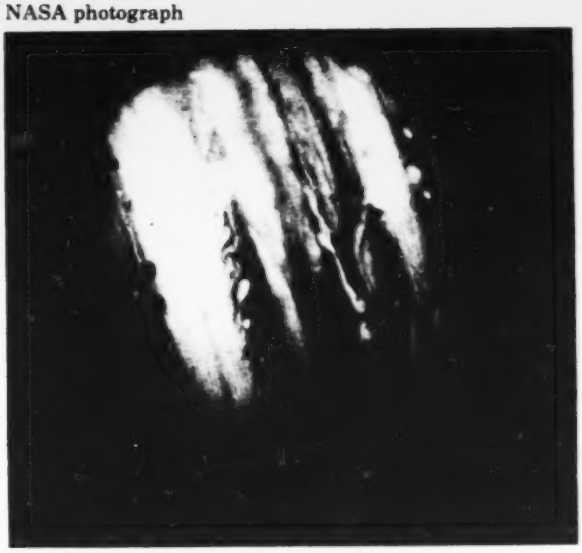
What kind of life do you think could live on Mars?

_____

_____

_____

NASA photograph



Jupiter

Jupiter is not like Earth, Mars, Venus, and Mercury. Jupiter is large, and it's made up mostly of gases. Those other planets are small. They are made up mostly of rock and metals.

Jupiter is more like Saturn, Neptune, and Uranus. Those four planets are sometimes called the Gas Giants.

Some scientists believe that Jupiter is completely covered with oceans of liquid hydrogen. They think that far beneath those oceans is a center made of rock and metals. That center is probably the size of Earth.

Look at the picture of Jupiter. It was taken by *Voyager I.* Notice the bands and stripes that go around Jupiter? They are part of Jupiter's atmosphere.

Jupiter's atmosphere is made up of very thick gases. So, *Voyager I* couldn't take pictures that showed what Jupiter looks like under its atmosphere.

Suppose you are in a spacecraft that is landing on Jupiter. Describe what that would be like.

NASA photograph

Saturn

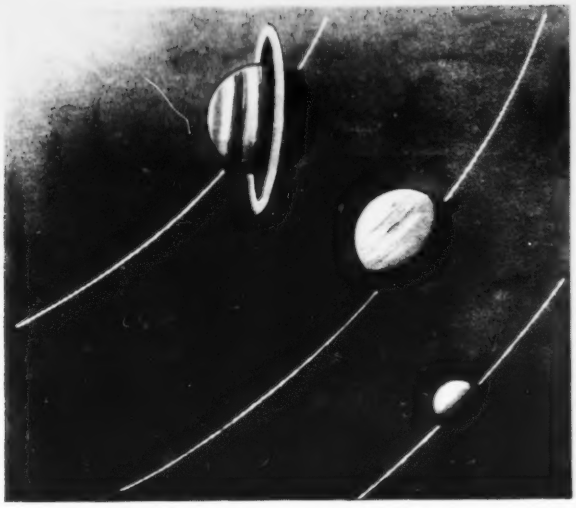
This picture of Saturn was taken by *Voyager II.* Notice the *rings* around the planet? What do you think those rings are made of?

Those rings are made of millions of bits of dust and ice. The dust and ice revolve around Saturn.

Before *Voyager II* explored Saturn, scientists thought Saturn had only three rings. Now we know there are at least seven main rings. We also know there are more than a thousand smaller rings—*ringlets.*

For a long time, scientists believed Saturn was the only planet with rings. Now we know Jupiter and Uranus have rings too. But Saturn still has the most rings.

Many people say that Saturn is the most beautiful planet in our solar system. Why do you think they say that?



NASA photograph

The Unknown Trio

Uranus, Neptune, and Pluto are the farthest planets from the sun. We don't know much about them. We've only been able to study them with telescopes.

Through telescopes, people discovered that Uranus has rings. They discovered that Neptune has an atmosphere. (Scientists think that Neptune's atmosphere is made up of gases such as hydrogen and methane.)

For many years, people thought that there were only eight planets in our solar system. They thought Neptune was the farthest planet from the sun. Then, in 1930, scientists discovered Pluto with a powerful telescope.

When space probes reach those three faraway planets, scientists hope to finally learn some of their secrets.

Voyager II is expected to pass Uranus and Neptune between 1986 and 1989. One day, another spacecraft will pass Pluto.

What would you want to find out about those three faraway planets?

_____

_____

_____

What Next in Space?

Right now, only unmanned spacecraft have made space probes to other planets. One day, scientists hope to send people on space probes.

In 1967, scientists began sending *space stations* into space. Those space stations move in orbits around Earth. They are large spacecraft that people can live and work in. One example of a space station is *Skylab I.*

In 1973 and 1974, three groups of astronauts lived in *Skylab I.* One group lived in it for 59 days—the longest that people have lived in space.

Scientists believe that one day we will have many space stations throughout our solar system. Manned spacecraft will stop at those space stations. Then they will continue on their space probes.

What do you think it would be like to live on a space station?

_____

_____

_____

_____

Check Yourself

Show what you learned in this unit. Answer these questions. Look back in the unit, if you need help.

1. Why do scientists use unmanned spacecraft to explore space?

   _____

   _____

   _____

   _____

2. Which planet in our solar system interests you the most?

   _____

   What have you learned about that planet so far?

   _____

   _____

   _____

   _____

   _____

   _____

   _____

Check These Out

1. There are many man-made satellites that revolve around Earth. Find out what some of those satellites are and what they are used for.
2. A spacecraft's trip to the moon is called a *moonshot*. So far, we've had six moonshots that carried astronauts to the moon. Find out about one of those moonshots. Then write a story or make a drawing about that moonshot.
3. Imagine you've been picked to live in a space station. Make a list of six things you would want to take with you. Next to each of those things, write why you would want to take it.
4. Here are some things you may want to find out:
   - What are observatories? How do they help us explore space?
   - What instruments are inside *Voyager II?* How do they send information back to Earth?
   - How do scientists on Earth control spacecraft that are moving through the solar system?

Show What You Learned

What's the Answer?

Each sentence has three correct endings. Put an **X** in front of each correct ending.

1. Our solar system is made up of
   _____ a. the sun.
   _____ b. planets and moons.
   _____ c. asteroids, comets, and meteoroids.
   _____ d. billions of stars.
2. All planets
   _____ a. are made up of hot and burning gases.
   _____ b. rotate around an axis.
   _____ c. have gravity.
   _____ d. revolve around the sun.
3. Earth
   _____ a. is the third planet from the sun.
   _____ b. rotates completely in 24 hours.
   _____ c. is a planet and a true star.
   _____ d. revolves around the sun in one year.
4. We have explored our solar system by
   _____ a. sending astronauts to the moon.
   _____ b. sending unmanned spacecraft on space probes.
   _____ c. sending astronauts to Mars.
   _____ d. training people to live in space stations.

What's the Word?

Write the correct word for each meaning.

1. A strong pull that all planets and stars have
   G_____
2. Spin around
   R_____
3. A huge ball of superhot gases that gives off heat and light; a sun
   S_____
4. Trips through the solar system to gather information about space
   S_____
5. The path a thing makes as it moves around another thing
   O_____
6. Millions of stars that form a group in space
   G_____

Congratulations!

You've learned a lot about our solar system.

You've learned:

- what's in the solar system;
- what stars and planets are;
- how planets move; and
- many other important facts about space travel and about the planets in our solar system.

Glossary

as ter oids: small pieces of planets that travel in space and revolve around the sun

as tro naut: a person who travels in space

at mos phere: layer of air around a planet

ax is: the straight line around which something spins

col lide: to crash with

com ets: frozen balls of gas, rock, and dust that have long orbits around the sun

cra ter: a hole in the ground that's shaped like a bowl

el lipse: a shape like a flat circle

gal ax y: millions of stars that form a group in space

grav i ty: a strong pull that all planets and stars have

me te or ites: rocks and dust from space that crash into planets

me te or oids: rocks and dust that travel through our solar system

me te ors: rocks and dust from space that burn up in Earth's atmosphere

NASA: (National Aeronautics and Space Administration) the United States program to explore space

ob ject: thing

or bit: the path a thing makes as it moves around another thing

plan ets: worlds such as Earth and the moon

re flect: bounce off something

re volve: move completely around something

ro tate: spin around

sat el lite: a small thing that moves around a larger thing

sea sons: the four parts of the year—winter, spring, summer, and fall

Sol: one of the names for the sun

so lar sys tem: the name of the star system that Earth is in

space craft: a spaceship

space probes: trips through the solar system to gather information about space

star: a huge ball of superhot gases that gives off heat and light; a sun

star sys tem: a star and all the things that move around it

tilt: tip or slant

true star: a sun

un manned space craft: a spaceship without people that travels through space

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